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NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

TECHNICAL NOTE

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DIRECT-READING DESIGN CHARTS FOR 24S-T ALUMINUM-ALLOY FLAT COMPRESSION PANELS HAVING LONGITUDINAL FORMED Z-SECTION STIFFENERS

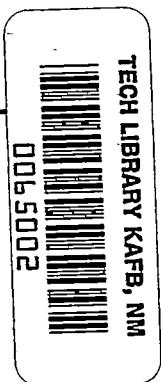
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Langley Aeronautical Laboratory
Langley Field, Va.



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TECHNICAL NOTE





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DIRECT-READING DESIGN CHARTS FOR 24S-T ALUMINUM-ALLOY
FLAT COMPRESSION PANELS HAVING LONGITUDINAL
FORMED Z-SECTION STIFFENERS

By Norris F. Dow and Albert S. Keevil, Jr.

SUMMARY

Direct-reading design charts are presented for 24S-T aluminum-alloy flat compression panels having longitudinal formed Z-section stiffeners. These charts make possible the direct determination of the stress and all the panel proportions required to carry a given intensity of loading with a given skin thickness and effective length of panel.

INTRODUCTION

Design charts for wing compression panels have been presented in several different forms. (See references 1 and 2.) In reference 3, a form was developed which permitted the direct selection of proportions for given values of the principal design conditions - intensity of loading, skin thickness, and effective length of panel. This form also made possible the ready determination of the proportions having minimum weight to meet these conditions. The charts presented in reference 3 covered 75S-T aluminum-alloy flat compression panels having longitudinal straight-web Y-section stiffeners. Similar charts for 24S-T aluminum-alloy panels with extruded, straight-web Y-section stiffeners are presented in reference 4, and direct-reading design charts for 24S-T aluminum-alloy panels with formed Z-section stiffeners are presented herein.

SYMBOLS

The symbols used for the panel dimensions are given in figure 1. In addition, the following symbols are used:

- c coefficient of end fixity as used in Euler column formula
- d rivet diameter, inches
- L length of panel, inches

p	rivet pitch, inches
P_1	compressive load per inch of panel width, kips per inch
\bar{t}	cross-sectional area per inch of panel width, expressed as an equivalent or average thickness, inches
ρ	radius of gyration, inches
$\bar{\sigma}_f$	average stress at failing load, ksi
σ_{cr}	stress for local buckling of sheet, ksi
σ_{cy}	compressive yield stress, ksi

DIRECT-READING DESIGN CHARTS

Direct-reading design charts for 24S-T aluminum-alloy flat compression panels with longitudinal formed Z-section stiffeners having the properties and proportions given in tables 1 to 5 are presented in two forms in figures 2 to 9. In the first form (figs. 2 to 5), the design conditions of intensity of loading, effective length of panel, and skin thickness

are incorporated in the ordinate P_1/t_S and the abscissa $\frac{P_1}{L/\sqrt{c}}$. This

form, having the design conditions incorporated in the ordinate and abscissa, is the more useful for most design purposes because the curves are more widely spaced and interpolation is more straightforward. In the second (alternate) form (figs. 6 to 9), the average stress at failure $\bar{\sigma}_f$ is plotted against P_1/t_S as was done in the summary plots of reference 5. This alternate form, having the stress - an inverse measure of weight for a given load - as ordinate, is the more useful for making generalizations and comparisons of structural efficiency because it shows how nearly the stress actually carried approaches the upper limit corresponding to the stress that would be achieved by a pure shell construction if a pure shell could carry the load without failure.

This upper limit of stress is represented by the lines for $\bar{\sigma}_f = \frac{P_1}{t_S}$ (infinite stiffener spacing) in figures 6 to 9.

Values of the ratios of stiffener thickness to skin thickness t_W/t_S , spacing of rivet lines to skin thickness S/t_S (because there is one rivet line associated with each Z-section, the stiffener spacing b_S is equal to S , the spacing of rivet lines), and height of stiffener to stiffener thickness H/t_W , which will satisfy the design conditions, may be found directly from these charts, and the corresponding section properties \bar{t}/t_S , \bar{h}/t_S , and ρ/t_S may be found from tables 2 to 5. In

the first form of design chart (figs. 2 to 5) dashed lines are used to indicate values of average stress at failure $\bar{\sigma}_f$; whereas, on the alternate form of design chart (figs. 6 to 9) dashed lines are used to indicate values of $\frac{P_i}{L/\sqrt{c}}$. In both forms the value of $\bar{\sigma}_f$ corresponding to the point at which each curve is cut by a short heavy line is the value of the stress for local buckling σ_{cr} for the proportions represented by the curves. For example, the value of σ_{cr} for $\frac{H}{t_W} = 21$ and $\frac{S}{t_S} = 35$ in figure 2 is approximately 29 ksi. (Only a short panel of these proportions would buckle before failure - one having a value of $\frac{P_i}{L/\sqrt{c}} \geq 0.27$.) If the value of σ_{cr} is so low that the short heavy line would fall outside the boundaries of the chart, a numerical value of σ_{cr} is given and is associated with the proper proportions by a leader to the curve. The panel proportions which have minimum weight are indicated on both forms of these charts by the use of colors as follows:

(1) If the proportions correspond to a blue region, they are the proportions which give the lightest possible 24S-T Z-stiffened panel which will meet the design conditions

(2) If the proportions correspond to a red region, they are the lightest possible at the ratio of stiffener thickness to skin thickness given by that particular chart, but some other thickness ratio would give a lighter design

(3) If the proportions correspond to a white region, the proportions meet the design conditions, but they are not the lightest which will meet the conditions

Because in many cases the proportions may be varied somewhat from those indicated by the red and blue regions with little change in the value of the stress that can be carried, too much importance should not be attached to the exact proportions indicated by the colors to have minimum weight. In any particular case for which a deviation from the minimum-weight proportions is made, however, caution dictates that the weight penalty associated with this deviation be determined.

The direct-reading design charts presented herein were developed in the manner described in reference 3 from the test data and resulting curves given in reference 2.

USE OF THE DIRECT-READING DESIGN CHARTS

The manner of using the direct-reading design charts depends in some measure on the desired degree of precision of interpolation among the curves. For many purposes, interpolation by inspection is of adequate accuracy, and the use of the charts requires only the calculation of the

values of the design parameters P_i/t_S and $\frac{P_i}{L/\sqrt{c}}$ to permit the desired

proportions to be read directly from the curves. The proportions for minimum weight, moreover, may be found directly as those corresponding to the blue region on the curves.

If more accurate interpolation is desired, a plot can readily be made of H/t_W , $\bar{\sigma}_F$, and σ_{cr} against S/t_S at the given values of P_i/t_S and $\frac{P_i}{L/\sqrt{c}}$ and the proportions can be picked from it. (This plot is

similar to that which results from the use of the minimum-weight design procedure with the previously available design charts as illustrated in reference 2.) On a plot of this type, the proportions for minimum weight correspond to those associated with the highest value of $\bar{\sigma}_F$.

As a check on the accuracy of interpolation, the cross-sectional area per inch of width of the design may be determined from the values of t/t_S given in tables 2 to 5 and the value of the intensity of loading P_i that can be carried on this cross-sectional area per inch at the value of $\bar{\sigma}_F$ given by the charts may then be compared with the design value of P_i .

ILLUSTRATIVE EXAMPLE

In order to illustrate the use of the direct reading design charts and the simplicity of the computations associated with them, a panel will be designed for minimum weight to meet the same principal design conditions used to illustrate the design procedures in reference 2, namely:

- (1) Intensity of loading $P_i = 3.0$ kips per inch
- (2) Skin thickness $t_S = 0.064$ inch
- (3) Effective length $L/\sqrt{c} = 20$ inches

First the values of P_1/t_S and $\frac{P_1}{L/\sqrt{c}}$ are calculated

$$\frac{P_1}{t_S} = \frac{3.0}{0.064}$$

$$= 46.9 \text{ ksi}$$

$$\frac{P_1}{L/\sqrt{c}} = \frac{3.0}{20/\sqrt{1}}$$

$$= 0.15 \text{ ksi}$$

Then a trial value of t_W/t_S is assumed (for the example $\frac{t_W}{t_S} = 0.79$ will be used). In the chart for this value of t_W/t_S (fig. 4) the points corresponding to the design values of P_1/t_S and $\frac{P_1}{L/\sqrt{c}}$ lie on the red line at $\frac{H}{t_W} = 26$ (or $\frac{b_W}{t_W} = 25$). Accordingly, the value of H/t_W for minimum weight for $\frac{t_W}{t_S} = 0.79$ is 26, and because the value is established by a red line, not a blue line, some value of t_W/t_S other than 0.79 will give less weight. Inspection of the charts for other values of t_W/t_S reveals that at the given design values of P_1/t_S and $\frac{P_1}{L/\sqrt{c}}$ the blue region lies between $\frac{H}{t_W} = 26$ and $\frac{H}{t_W} = 31$ on the chart for $\frac{t_W}{t_S} = 0.63$.

By interpolation, the panel proportions corresponding to this blue region are found to be $\frac{H}{t_W} \approx 29.5$ ($\frac{b_W}{t_W} \approx 28.5$) and $\frac{S}{t_S} = \frac{b_S}{t_S} \approx 35$,

and for these proportions $\bar{\sigma}_f \approx 30.5 \text{ ksi}$ and $\sigma_{cr} \approx 30.5 \text{ ksi}$, which are the values for minimum weight. The actual panel dimensions can be calculated from these proportions as

$$t_W = \frac{t_W}{t_S} t_S$$

$$= 0.63(0.064)$$

$$= 0.0403 \text{ inch}$$

$$H = \frac{H}{t_W} t_W$$

$$= 29.5 (0.040)$$

$$= 1.18 \text{ inches}$$

$$S = \frac{S}{t_S} t_S$$

$$= 35(0.064)$$

$$= 2.24 \text{ inches}$$

and the section properties can be determined from table 3 as

$$\bar{h} = \frac{\bar{h}}{t_S} t_S$$

$$= 3.92(0.064)$$

$$= 0.251 \text{ inch}$$

$$\rho = \frac{\rho}{t_S} t_S$$

$$= 6.02(0.064)$$

$$= 0.385 \text{ inch}$$

In order to illustrate the use of the direct-reading design charts when more accuracy than that corresponding to interpolation by inspection is desired, a plot has been made (fig. 10) of the values of $\bar{\sigma}_f$, σ_{cr} , and H/t_W given by the charts at the design values of P_1/t_S and $\frac{P_1}{L/\sqrt{c}}$.

The proportions which give the highest value of $\bar{\sigma}_f$ can be readily selected from a plot of this kind. (For the example these proportions are so nearly the same as were obtained by inspection that the values will not be repeated.)

As a check on the accuracy of interpolation, the magnitude of \bar{t}/t_S for these proportions can be determined from table 3 and multiplied by the values of t_S and $\bar{\sigma}_f$ for the design. This product should be equal to the design value of P_i . For the example

$$\bar{\sigma}_f = 30.5 \text{ ksi}$$

$$\frac{\bar{t}}{t_S} = 1.538$$

and

$$\begin{aligned} P_i &= \bar{\sigma}_f \bar{t} \\ &= \bar{\sigma}_f \frac{\bar{t}}{t_S} t_S \\ &= 30.5(1.538)(0.064) \\ &= 3.0 \text{ kips per inch} \end{aligned}$$

which agrees with the design value of P_i originally assumed.

Langley Aeronautical Laboratory
 National Advisory Committee for Aeronautics
 Langley Field, Va., August 2, 1948

REFERENCES

1. Langhaar, Henry L.: Design of Hat-Type Plate-Stringer Combinations. Auto. and Aviation Ind., vol. 91, no. 11, Dec. 1, 1944, pp. 28-32 and 103-104.
2. Schuette, Evan H.: Charts for the Minimum-Weight Design of 24S-T Aluminum-Alloy Flat Compression Panels with Longitudinal Z-Section Stiffeners. NACA Rep. No. 827, 1945.
3. Dow, Norris F., and Hickman, William A.: Direct-Reading Design Charts for 75S-T Aluminum-Alloy Flat Compression Panels Having Longitudinal Straight-Web Y-Section Stiffeners. NACA TN No. 1640, 1948.
4. Dow, Norris F., Hubka, Ralph E., and Roberts, William M.: Direct-Reading Design Charts for 24S-T Aluminum-Alloy Flat Compression Panels Having Longitudinal Straight-Web Y-Section Stiffeners. NACA TN No. 1777, 1949.
5. Dow, Norris F., and Hickman, William A.: Design Charts for Flat Compression Panels Having Longitudinal Extruded Y-Section Stiffeners and Comparison with Panels Having Formed Z-Section Stiffeners. NACA TN No. 1389, 1947.

TABLE 1.- MATERIAL PROPERTIES OF 24S-T
ALUMINUM-ALLOY PANELS HAVING FORMED
Z-SECTION STIFFENERS

	Aluminum alloy	σ_{cy} (ksi)
Sheet	24S-T bare	44.0
Stiffeners	24S-T bare sheet before forming	44.0



TABLE 2.- Z-PANEL PROPERTIES $\frac{t_w}{t_s} = 0.51$; $\frac{b_A}{t_w} = 11.4$; $\frac{b_T}{t_w} = 0.4$; $\frac{r_A}{t_w} = 3$; $\frac{r_T}{t_w} = 4$; $\frac{d}{t_s} = 1.50$; $\frac{p}{t_B} = 10.0$

$\frac{b_w}{t_s}$	20	21	22	23	24	25	26	27	28	29	30	31	32
25	1.374	1.389	1.403	1.418	1.432	1.447	1.462	1.476	1.491	1.505	1.520	1.535	1.549
	1.360	1.374	1.389	1.402	1.416	1.430	1.444	1.458	1.472	1.486	1.500	1.514	1.528
	1.346	1.360	1.373	1.387	1.400	1.414	1.427	1.441	1.454	1.468	1.481	1.495	1.508
	1.334	1.347	1.360	1.373	1.386	1.399	1.412	1.425	1.438	1.451	1.464	1.477	1.490
	1.323	1.335	1.348	1.360	1.373	1.385	1.398	1.410	1.423	1.436	1.448	1.461	1.473
30	1.312	1.324	1.336	1.348	1.360	1.373	1.385	1.397	1.409	1.421	1.433	1.445	1.457
	1.302	1.313	1.325	1.337	1.349	1.360	1.372	1.384	1.396	1.407	1.419	1.431	1.443
	1.292	1.301	1.315	1.326	1.338	1.349	1.361	1.372	1.383	1.395	1.406	1.418	1.429
	1.283	1.294	1.306	1.317	1.328	1.339	1.350	1.361	1.372	1.383	1.394	1.405	1.416
	1.275	1.286	1.297	1.307	1.318	1.329	1.339	1.350	1.361	1.372	1.382	1.393	1.404
35	1.267	1.278	1.283	1.298	1.309	1.319	1.330	1.340	1.350	1.361	1.371	1.382	1.392
	1.260	1.270	1.280	1.290	1.300	1.310	1.321	1.331	1.341	1.351	1.361	1.371	1.381
	1.253	1.263	1.272	1.282	1.292	1.302	1.312	1.322	1.332	1.341	1.351	1.361	1.371
	1.246	1.256	1.265	1.275	1.285	1.294	1.304	1.313	1.323	1.332	1.342	1.352	1.361
	1.239	1.249	1.259	1.268	1.277	1.287	1.296	1.305	1.315	1.324	1.333	1.343	1.352
40	1.230	1.242	1.252	1.261	1.270	1.279	1.288	1.298	1.307	1.316	1.325	1.334	1.343
	1.223	1.231	1.240	1.249	1.257	1.266	1.275	1.283	1.292	1.301	1.309	1.318	1.327
	1.213	1.221	1.229	1.237	1.246	1.254	1.262	1.271	1.279	1.287	1.295	1.304	1.312
	1.203	1.211	1.219	1.227	1.235	1.243	1.251	1.259	1.267	1.275	1.283	1.290	1.298
	1.195	1.202	1.210	1.218	1.225	1.232	1.240	1.248	1.256	1.263	1.271	1.279	1.286
50	1.197	1.198	1.202	1.208	1.216	1.224	1.231	1.238	1.242	1.253	1.260	1.267	1.274
	1.180	1.187	1.194	1.201	1.203	1.215	1.222	1.229	1.236	1.243	1.250	1.257	1.264
	1.173	1.180	1.187	1.193	1.200	1.207	1.214	1.220	1.227	1.234	1.241	1.248	1.254
	1.167	1.174	1.180	1.187	1.193	1.200	1.206	1.213	1.219	1.226	1.232	1.239	1.245
	1.161	1.168	1.174	1.180	1.186	1.193	1.199	1.205	1.212	1.218	1.224	1.231	1.237
60	1.156	1.162	1.168	1.174	1.180	1.186	1.192	1.193	1.201	1.211	1.217	1.223	1.229
	1.144	1.150	1.155	1.161	1.166	1.172	1.178	1.183	1.189	1.194	1.200	1.206	1.211
	1.134	1.139	1.144	1.149	1.154	1.160	1.165	1.170	1.175	1.180	1.186	1.191	1.196
	1.125	1.130	1.134	1.139	1.144	1.148	1.154	1.159	1.164	1.168	1.173	1.178	1.183
	1.114	1.118	1.124	1.128	1.132	1.136	1.141	1.146	1.151	1.156	1.161	1.166	1.171
70	1.096	1.098	1.102	1.106	1.110	1.114	1.118	1.122	1.126	1.130	1.134	1.138	1.142
	1.087	1.091	1.095	1.099	1.103	1.107	1.111	1.115	1.119	1.123	1.127	1.131	1.135
	1.079	1.083	1.087	1.091	1.095	1.099	1.103	1.107	1.111	1.115	1.119	1.123	1.127
	1.071	1.075	1.079	1.083	1.087	1.091	1.095	1.099	1.103	1.107	1.111	1.115	1.119
	1.063	1.067	1.071	1.075	1.079	1.083	1.087	1.091	1.095	1.099	1.103	1.107	1.111
75	1.055	1.059	1.063	1.067	1.071	1.075	1.079	1.083	1.087	1.091	1.095	1.099	1.103
	1.047	1.051	1.055	1.059	1.063	1.067	1.071	1.075	1.079	1.083	1.087	1.091	1.095
	1.040	1.044	1.048	1.052	1.056	1.060	1.064	1.068	1.072	1.076	1.080	1.084	1.088
	1.033	1.037	1.041	1.045	1.049	1.053	1.057	1.061	1.065	1.069	1.073	1.077	1.081
	1.025	1.029	1.033	1.037	1.041	1.045	1.049	1.053	1.057	1.061	1.065	1.069	1.073
80	1.017	1.021	1.025	1.029	1.033	1.037	1.041	1.045	1.049	1.053	1.057	1.061	1.065
	1.010	1.014	1.018	1.022	1.026	1.030	1.034	1.038	1.042	1.046	1.050	1.054	1.058
	1.003	1.007	1.011	1.015	1.019	1.023	1.027	1.031	1.035	1.039	1.043	1.047	1.051
	0.996	0.999	1.003	1.007	1.011	1.015	1.019	1.023	1.027	1.031	1.035	1.039	1.043
	0.989	0.992	0.996	0.999	1.003	1.007	1.011	1.015	1.019	1.023	1.027	1.031	1.035
90	0.982	0.985	0.988	0.991	0.994	0.997	1.000	1.003	1.006	1.009	1.012	1.015	1.018
	0.975	0.978	0.981	0.984	0.987	0.990	0.993	0.996	0.999	1.002	1.005	1.008	1.011
	0.968	0.971	0.974	0.977	0.980	0.983	0.986	0.989	0.992	0.995	0.998	1.001	1.004
	0.961	0.964	0.967	0.970	0.973	0.976	0.979	0.982	0.985	0.988	0.991	0.994	1.007
	0.954	0.957	0.960	0.963	0.966	0.969	0.972	0.975	0.978	0.981	0.984	0.987	1.000
100	0.947	0.950	0.953	0.956	0.959	0.962	0.965	0.968	0.971	0.974	0.977	0.980	0.983
	0.940	0.943	0.946	0.949	0.952	0.955	0.958	0.961	0.964	0.967	0.970	0.973	0.976
	0.933	0.936	0.939	0.942	0.945	0.948	0.951	0.954	0.957	0.960	0.963	0.966	0.969
	0.926	0.929	0.932	0.935	0.938	0.941	0.944	0.947	0.950	0.953	0.956	0.959	0.962
	0.919	0.922	0.925	0.928	0.931	0.934	0.937	0.940	0.943	0.946	0.949	0.952	0.955
110	0.912	0.915	0.918	0.921	0.924	0.927	0.930	0.933	0.936	0.939	0.942	0.945	0.948
	0.905	0.908	0.911	0.914	0.917	0.920	0.923	0.926	0.929	0.932	0.935	0.938	0.941
	0.898	0.901	0.904	0.907	0.910	0.913	0.916	0.919	0.922	0.925	0.928	0.931	0.934
	0.891	0.894	0.897	0.900	0.903	0.906	0.909	0.912	0.915	0.918	0.921	0.924	0.927
	0.884	0.887	0.890	0.893	0.896	0.899	0.902	0.905	0.908	0.911	0.914	0.917	0.920
120	0.877	0.880	0.883	0.886	0.889	0.892	0.895	0.898	0.901	0.904	0.907	0.910	0.913
	0.870	0.873	0.876	0.879	0.882	0.885	0.888	0.891	0.894	0.897	0.900	0.903	0.906
	0.863	0.866	0.869	0.872	0.875	0.878	0.881	0.884	0.887	0.890	0.893	0.896	0.899
	0.856	0.859	0.862	0.865	0.868	0.871	0.874	0.877	0.880	0.883	0.886	0.889	0.892
	0.849	0.852	0.855	0.858	0.861	0.864	0.867	0.870	0.873	0.876	0.879	0.882	0.885
130	0.842	0.845	0.848	0.851	0.854	0.857	0.860	0.863	0.866	0.869	0.872	0.875	0.878
	0.835	0.838	0.841	0.844	0.847	0.850	0.853	0.856	0.859	0.862	0.865	0.868	0.871
	0.828	0.831	0.834	0.837	0.840	0.843	0.846	0.849	0.852	0.855	0.858	0.861	0.864
	0.821	0.824	0.827	0.830	0.833	0.836	0.839	0.842	0.845	0.848	0.851	0.854	0.857
	0.814	0.817	0.820	0.823	0.826	0.829	0.832	0.835	0.838	0.841	0.844	0.847	0.850

TABLE 2.- Z-PANEL PROPERTIES - Continued

$$\frac{b_w}{t_s} = 0.51; \frac{b_A}{t_w} = 11.4; \frac{b_F}{t_w} = 0.4; \frac{r_A}{t_w} = 3; \frac{r_F}{t_s} = 4; \frac{d}{t_s} = 1.50; \frac{p}{t_s} = 10.0$$

$\frac{b_w}{t_s}$	33	34	35	36	37	38	39	40	41	42	43	44	45
25	1.564	1.578	1.593	1.607	1.622	1.636	1.651	1.665	1.680	1.695	1.710	1.724	1.739
26	1.512	1.556	1.570	1.584	1.598	1.612	1.626	1.640	1.654	1.668	1.682	1.696	1.710
27	1.522	1.535	1.549	1.562	1.576	1.589	1.603	1.616	1.630	1.643	1.657	1.670	1.684
28	1.503	1.516	1.529	1.542	1.555	1.568	1.581	1.594	1.607	1.620	1.633	1.646	1.659
29	1.488	1.498	1.511	1.523	1.536	1.549	1.561	1.574	1.586	1.599	1.612	1.624	1.637
30	1.469	1.482	1.495	1.506	1.517	1.530	1.543	1.555	1.567	1.579	1.591	1.603	1.615
31	1.455	1.466	1.479	1.490	1.502	1.513	1.525	1.537	1.549	1.560	1.572	1.584	1.596
32	1.441	1.452	1.464	1.474	1.486	1.497	1.509	1.520	1.532	1.543	1.554	1.565	1.577
33	1.427	1.438	1.449	1.460	1.471	1.482	1.493	1.504	1.515	1.526	1.537	1.548	1.559
34	1.415	1.425	1.436	1.446	1.457	1.468	1.479	1.489	1.500	1.511	1.522	1.532	1.543
35	1.403	1.413	1.424	1.434	1.445	1.455	1.465	1.475	1.486	1.496	1.507	1.517	1.528
36	1.391	1.401	1.411	1.422	1.432	1.442	1.452	1.462	1.472	1.482	1.493	1.503	1.513
37	1.381	1.391	1.401	1.410	1.420	1.430	1.440	1.450	1.460	1.469	1.479	1.489	1.499
38	1.371	1.380	1.390	1.399	1.409	1.419	1.429	1.438	1.448	1.457	1.467	1.476	1.486
39	1.362	1.371	1.380	1.389	1.399	1.408	1.415	1.427	1.436	1.445	1.455	1.464	1.474
40	1.352	1.361	1.370	1.380	1.389	1.398	1.407	1.416	1.425	1.434	1.443	1.452	1.462
41	1.336	1.344	1.353	1.361	1.370	1.379	1.388	1.396	1.405	1.413	1.422	1.431	1.440
42	1.321	1.328	1.337	1.345	1.354	1.362	1.370	1.378	1.387	1.395	1.403	1.411	1.420
43	1.306	1.314	1.322	1.330	1.338	1.346	1.351	1.362	1.370	1.377	1.385	1.393	1.401
44	1.294	1.301	1.309	1.316	1.324	1.331	1.339	1.347	1.355	1.362	1.370	1.377	1.385
45	1.281	1.289	1.297	1.301	1.311	1.318	1.326	1.333	1.340	1.347	1.352	1.356	1.369
46	1.271	1.278	1.285	1.292	1.299	1.306	1.313	1.320	1.327	1.334	1.341	1.348	1.355
47	1.261	1.268	1.274	1.281	1.288	1.295	1.302	1.308	1.315	1.322	1.329	1.335	1.342
48	1.252	1.258	1.265	1.271	1.278	1.284	1.291	1.297	1.304	1.310	1.317	1.323	1.330
49	1.241	1.249	1.256	1.262	1.268	1.274	1.281	1.287	1.293	1.299	1.305	1.312	1.318
50	1.235	1.241	1.247	1.253	1.259	1.265	1.271	1.277	1.283	1.289	1.295	1.302	1.308
51	1.217	1.222	1.224	1.234	1.239	1.245	1.250	1.256	1.262	1.267	1.273	1.278	1.284
52	1.201	1.206	1.211	1.217	1.222	1.227	1.233	1.238	1.243	1.248	1.253	1.258	1.264
53	1.188	1.193	1.198	1.202	1.208	1.212	1.217	1.222	1.227	1.232	1.237	1.241	1.246
54	3.876	4.049	4.223	4.402	4.581	4.766	4.950	5.140	5.329	5.520	5.713	5.913	6.110
55	3.792	3.961	4.132	4.306	4.483	4.663	4.844	5.028	5.216	5.405	5.597	5.790	5.986
56	3.712	3.878	4.045	4.217	4.389	4.566	4.744	4.926	5.108	5.295	5.482	5.674	5.865
57	3.637	3.799	3.962	4.131	4.301	4.474	4.649	4.827	5.007	5.190	5.375	5.562	5.751
58	3.562	3.723	3.884	4.049	4.215	4.384	4.557	4.731	4.909	5.087	5.268	5.453	5.638
59	3.495	3.649	3.811	3.970	4.137	4.301	4.478	4.650	4.814	4.991	5.170	5.351	5.535
60	3.426	3.581	3.733	3.894	4.054	4.220	4.385	4.553	4.723	4.899	5.074	5.251	5.430
61	3.362	3.513	3.665	3.824	3.980	4.142	4.303	4.470	4.637	4.808	4.982	5.159	5.334
62	3.303	3.451	3.601	3.751	3.909	4.067	4.228	4.391	4.556	4.724	4.894	5.067	5.211
63	3.244	3.390	3.537	3.689	3.841	3.995	4.152	4.315	4.476	4.641	4.807	4.979	5.149
64	3.188	3.331	3.475	3.623	3.772	3.926	4.082	4.241	4.399	4.563	4.726	4.894	5.061
65	3.136	3.276	3.419	3.562	3.710	3.861	4.014	4.169	4.327	4.487	4.647	4.811	4.978
66	3.083	3.220	3.360	3.505	3.650	3.797	3.947	4.099	4.251	4.411	4.573	4.711	4.898
67	3.034	3.170	3.307	3.449	3.591	3.735	3.882	4.034	4.185	4.342	4.498	4.659	4.820
68	2.985	3.119	3.218	3.394	3.533	3.677	3.821	3.987	4.121	4.275	4.428	4.586	4.743
69	2.914	3.072	3.206	3.476	3.620	3.763	3.910	4.058	4.209	4.362	4.517	4.671	
70	2.852	2.980	3.109	3.213	3.376	3.512	3.650	3.794	3.937	4.085	4.232	4.381	4.533
71	2.771	2.896	3.020	3.119	3.278	3.338	3.471	3.605	3.823	3.965	4.110	4.258	4.404
72	2.697	2.816	2.938	3.052	3.189	3.318	3.449	3.582	3.718	3.859	3.999	4.141	4.285
73	2.625	2.742	2.860	2.982	3.104	3.231	3.358	3.487	3.618	3.751	3.889	4.030	4.169
74	2.561	2.675	2.786	2.904	3.025	3.147	3.270	3.397	3.527	3.659	3.790	3.926	4.064
75	2.497	2.607	2.719	2.833	2.950	3.069	3.190	3.313	3.439	3.567	3.696	3.828	3.962
76	2.439	2.545	2.655	2.766	2.879	2.995	3.112	3.234	3.356	3.480	3.606	3.736	3.866
77	2.383	2.488	2.593	2.702	2.812	2.922	3.040	3.159	3.277	3.400	3.522	3.649	3.775
78	2.329	2.432	2.525	2.642	2.750	2.861	2.972	3.087	3.204	3.321	3.445	3.566	3.691
79	2.281	2.380	2.482	2.585	2.691	2.799	2.909	3.021	3.135	3.251	3.369	3.486	3.608
80	2.169	2.263	2.358	2.454	2.555	2.656	2.761	2.865	2.972	3.083	3.194	3.309	3.423
81	2.070	2.159	2.249	2.340	2.435	2.531	2.628	2.728	2.831	2.935	3.041	3.149	3.257
82	1.981	2.065	2.150	2.239	2.326	2.419	2.512	2.607	2.704	2.802	2.902	3.007	3.110
83	5.805	6.030	6.255	6.481	6.706	6.932	7.158	7.385	7.611	7.837	8.061	8.291	8.517
84	5.757	5.981	6.205	6.429	6.655	6.880	7.105	7.334	7.557	7.790	8.010	8.236	8.463
85	5.709	5.933	6.155	6.380	6.605	6.829	7.053	7.279	7.504	7.730	7.955	8.182	8.408
86	5.663	5.882	6.107	6.330	6.554	6.778	7.002	7.227	7.452	7.677	7.902	8.128	8.354
87	5.616	5.838	6.059	6.282	6.501	6.727	6.900	7.124	7.347	7.572	7.796	8.021	8.246
88	5.572	5.791	6.013	6.234	6.457	6.679	6.890	7.112	7.334	7.557	7.776	8.012	8.232
89	5.526	5.746	5.965	6.186	6.406	6.629	6.835	7.054	7.277	7.501	7.714	7.968	8.192
90	5.483	5.701	5.919	6.111	6.330	6.551	6.764	6.976	7.198	7.420	7.643	7.866	8.089
91	5.441	5.658	5.876	6.095	6.315	6.534	6.755	6.976	7.198	7.410	7.633	7.853	8.037
92	5.398	5.615	5.832	6.051	6.269	6.488	6.707	6.929	7.149	7.370	7.592	7.815	
93	5.357	5.578	5.788	6.006	6.225	6.442	6.661	6.881	7.101	7.322	7.542	7.736	7.986
94	5.313	5.532	5.748	5.963	6.180	6.397	6.616	6.832	7.054	7.275	7.494	7.715	7.937
95	5.278	5.492	5.705	5.921	6.137	6.353	6.570	6.788	7.007	7.228	7.447	7.663	7.888
96	5.239	5.452	5.665	5.880	6.094	6.309	6.525	6.743	6.960	7.180	7.399	7.619	

TABLE 3.- Z-PANEL PROPERTIES $\frac{t_w}{t_b} = 0.63; \frac{b_A}{t_w} = 10.9; \frac{b_F}{t_w} = 0.4; \frac{r_A}{t_w} = 3; \frac{r_F}{t_w} = 4; \frac{d}{t_b} = 1.84; \frac{P}{t_b} = 12.3$

$\frac{b_A}{t_w}$	20	21	22	23	24	25	26	27	28	29	30	31	32
25	1.563	1.585	1.608	1.630	1.652	1.674	1.696	1.719	1.741	1.763	1.785	1.808	1.830
26	1.541	1.563	1.584	1.606	1.627	1.648	1.670	1.691	1.722	1.754	1.775	1.777	1.798
27	1.521	1.542	1.563	1.583	1.601	1.621	1.645	1.665	1.686	1.707	1.727	1.748	1.768
28	1.503	1.523	1.542	1.562	1.582	1.602	1.622	1.642	1.662	1.681	1.703	1.721	1.741
29	1.485	1.505	1.524	1.543	1.562	1.581	1.600	1.620	1.639	1.658	1.677	1.696	1.715
30	1.469	1.488	1.506	1.525	1.543	1.562	1.580	1.599	1.617	1.636	1.654	1.673	1.692
31	1.451	1.472	1.490	1.508	1.526	1.544	1.562	1.580	1.598	1.615	1.633	1.651	1.669
32	1.440	1.457	1.475	1.492	1.509	1.527	1.544	1.561	1.586	1.604	1.621	1.639	1.648
33	1.427	1.443	1.460	1.477	1.494	1.511	1.528	1.544	1.561	1.578	1.595	1.612	1.629
34	1.411	1.430	1.447	1.465	1.484	1.503	1.520	1.538	1.556	1.573	1.591	1.609	1.616
35	1.402	1.418	1.434	1.450	1.466	1.482	1.497	1.513	1.530	1.545	1.561	1.577	1.593
36	1.391	1.406	1.422	1.437	1.453	1.468	1.484	1.499	1.515	1.530	1.545	1.561	1.576
37	1.380	1.395	1.411	1.426	1.441	1.456	1.471	1.486	1.501	1.516	1.531	1.546	1.561
38	1.370	1.385	1.400	1.414	1.429	1.444	1.458	1.473	1.487	1.502	1.517	1.532	1.546
39	1.361	1.375	1.389	1.404	1.422	1.446	1.461	1.475	1.489	1.502	1.518	1.532	1.546
40	1.352	1.366	1.380	1.394	1.408	1.423	1.435	1.449	1.463	1.477	1.491	1.505	1.519
42	1.335	1.348	1.362	1.375	1.388	1.403	1.415	1.428	1.441	1.454	1.467	1.481	1.494
44	1.320	1.333	1.345	1.358	1.370	1.383	1.396	1.408	1.421	1.434	1.446	1.459	1.471
46	1.306	1.318	1.330	1.342	1.354	1.366	1.379	1.391	1.403	1.415	1.427	1.439	1.451
48	1.293	1.305	1.317	1.328	1.340	1.351	1.362	1.374	1.386	1.397	1.409	1.421	1.432
50	1.282	1.293	1.304	1.315	1.326	1.337	1.348	1.359	1.370	1.382	1.393	1.404	1.415
52	1.271	1.281	1.292	1.303	1.313	1.324	1.335	1.346	1.356	1.367	1.378	1.389	1.399
54	1.261	1.271	1.281	1.292	1.302	1.312	1.322	1.333	1.343	1.353	1.364	1.374	1.384
56	1.251	1.261	1.271	1.281	1.291	1.301	1.311	1.321	1.331	1.341	1.351	1.361	1.370
58	1.241	1.252	1.262	1.271	1.281	1.291	1.300	1.310	1.319	1.329	1.339	1.349	1.358
60	1.235	1.244	1.253	1.262	1.272	1.281	1.290	1.299	1.309	1.318	1.327	1.337	1.346
65	1.217	1.225	1.234	1.242	1.251	1.259	1.268	1.276	1.285	1.294	1.302	1.311	1.329
70	1.201	1.209	1.217	1.225	1.233	1.241	1.249	1.257	1.265	1.273	1.280	1.288	1.296
75	1.188	1.195	1.203	1.210	1.217	1.225	1.232	1.240	1.247	1.254	1.262	1.270	1.277
25	2.813	3.043	3.216	3.457	3.673	3.894	4.120	4.348	4.583	4.822	5.066	5.311	5.562
26	2.785	2.979	3.180	3.365	3.597	3.815	4.034	4.261	4.492	4.725	4.965	5.206	5.454
27	2.729	2.920	3.116	3.319	3.525	3.739	3.955	4.179	4.404	4.633	4.870	5.107	5.352
28	2.675	2.862	3.057	3.255	3.458	3.666	3.879	4.097	4.319	4.547	4.778	5.012	5.251
29	2.625	2.808	3.098	3.162	3.393	3.598	3.807	4.019	4.239	4.462	4.689	4.921	5.156
30	2.577	2.757	2.913	3.153	3.351	3.531	3.738	3.947	4.163	4.381	4.606	4.842	5.062
31	2.551	2.708	2.890	3.077	3.270	3.467	3.669	3.876	4.087	4.305	4.522	4.749	4.976
32	2.487	2.661	2.836	3.024	3.211	3.408	3.606	3.811	4.017	4.230	4.445	4.666	4.891
33	2.444	2.616	2.791	2.972	3.158	3.318	3.513	3.716	3.950	4.161	4.371	4.588	4.808
34	2.404	2.572	2.711	2.922	3.106	3.292	3.485	3.683	3.883	4.089	4.300	4.512	4.731
35	2.366	2.550	2.699	2.874	3.054	3.238	3.429	3.623	3.818	4.023	4.222	4.439	4.641
36	2.328	2.490	2.656	2.829	3.005	3.187	3.372	3.564	3.758	3.952	4.163	4.369	4.562
37	2.293	2.452	2.614	2.783	2.957	3.136	3.320	3.507	3.698	3.896	4.097	4.301	4.510
38	2.259	2.414	2.575	2.743	2.913	3.088	3.270	3.454	3.645	3.838	4.035	4.235	4.442
39	2.225	2.379	2.538	2.700	2.869	3.043	3.221	3.402	3.583	3.781	3.976	4.173	4.376
40	2.193	2.304	2.500	2.661	2.828	2.999	3.174	3.353	3.537	3.724	3.916	4.112	4.311
42	2.133	2.230	2.430	2.586	2.748	2.914	3.082	3.257	3.436	3.620	3.807	3.996	4.191
44	2.076	2.217	2.365	2.516	2.674	2.834	2.998	3.169	3.342	3.519	3.702	3.887	4.078
46	2.024	2.145	2.304	2.452	2.604	2.760	2.919	3.084	3.253	3.427	3.604	3.785	3.970
48	1.975	2.108	2.213	2.390	2.537	2.690	2.816	3.007	3.171	3.341	3.513	3.688	3.869
50	1.928	2.058	2.193	2.332	2.476	2.625	2.777	2.924	3.091	3.257	3.425	3.597	3.773
52	1.835	2.013	2.143	2.278	2.419	2.563	2.711	2.862	3.020	3.180	3.343	3.510	3.683
54	1.814	1.968	2.096	2.227	2.364	2.505	2.650	2.797	2.950	3.108	3.266	3.431	3.599
56	1.807	1.927	2.051	2.180	2.312	2.449	2.590	2.725	2.884	3.037	3.193	3.353	3.519
58	1.770	1.887	2.008	2.135	2.261	2.397	2.535	2.676	2.823	2.971	3.123	3.279	3.440
60	1.735	1.850	1.963	2.091	2.217	2.348	2.483	2.622	2.763	2.909	3.059	3.210	3.368
65	1.657	1.765	1.876	1.992	2.111	2.236	2.362	2.494	2.628	2.765	2.908	3.052	3.201
70	1.589	1.690	1.796	1.905	2.018	2.135	2.255	2.379	2.507	2.638	2.774	2.912	3.053
75	1.527	1.624	1.723	1.828	1.936	2.046	2.161	2.278	2.400	2.526	2.653	2.782	2.918
25	4.017	4.299	4.581	4.862	5.146	5.430	5.713	5.996	6.280	6.564	6.848	7.131	7.414
26	3.994	4.264	4.538	4.825	5.108	5.391	5.673	5.956	6.239	6.522	6.805	7.088	7.371
27	3.952	4.229	4.509	4.790	5.070	5.352	5.633	5.915	6.198	6.480	6.763	7.045	7.329
28	3.918	4.198	4.475	4.753	5.033	5.313	5.594	5.875	6.157	6.439	6.721	7.003	7.285
29	3.887	4.163	4.110	4.717	4.986	5.276	5.556	5.835	6.116	6.398	6.679	6.961	7.243
30	3.856	4.130	4.106	4.682	4.960	5.258	5.538	5.791	6.077	6.357	6.638	6.919	7.200
31	3.825	4.099	4.373	4.648	4.921	5.201	5.479	5.757	6.037	6.317	6.597	6.872	7.159
32	3.795	4.068	4.342	4.614	4.889	5.165	5.442	5.720	5.998	6.277	6.556	6.836	7.116
33	3.766	4.037	4.308	4.580	4.854	5.129	5.405	5.682	5.960	6.240	6.516	6.795	7.071
34	3.737	4.007	4.276	4.557	4.821	5.095	5.370	5.651	5.921	6.199	6.477	6.755	7.034
35	3.709	3.977	4.215	4.516	4.787	5.060	5.331	5.608	5.882	6.160	6.437	6.715	6.994
36	3.683	3.943	4.194	4.501	4.751	5.025	5.298	5.572	5.847	6.122	6.399	6.675	6.953
37	3.651	3.919	4.141	4.452	4.722	5.002	5.261	5.535	5.811	6.084	6.360	6.636	6.912
38	3.620	3.880	4.155	4.422	4.689	4.959	5.230	5.501	5.775	6.048	6.322	6.600	6.873
39	3.601	3.862	4.127	4.397	4.658	4.927	5.197	5.466	5.739	6.012	6.285	6.556	6.834
40	3.575	3.826	4.093	4.361	4.627	4.89							

TABLE 3.- Z-PANEL PROPERTIES - Consolidated
 $\frac{W}{t_B} = 0.63; \frac{b_A}{t_W} = 10.9; \frac{b_T}{t_W} = 0.4; \frac{r_A}{t_W} = 3; \frac{r_T}{t_W} = 4; \frac{d}{t_B} = 1.84; \frac{L}{t_B} = 12.3$

$\frac{b_W}{t_B}$		33	34	35	36	37	38	39	40	41	42	43	44	45
25		1.853	1.874	1.897	1.919	1.941	1.963	1.986	2.008	2.030	2.052	2.075	2.097	2.119
26		1.820	1.841	1.862	1.883	1.905	1.926	1.948	1.969	1.991	2.012	2.033	2.054	2.076
27		1.789	1.810	1.831	1.851	1.871	1.892	1.913	1.933	1.954	1.974	1.995	2.015	2.036
28		1.761	1.781	1.801	1.820	1.840	1.860	1.880	1.900	1.920	1.939	1.959	1.979	1.999
29		1.734	1.754	1.773	1.792	1.811	1.830	1.850	1.869	1.888	1.907	1.926	1.945	1.965
30		1.711	1.729	1.748	1.766	1.785	1.803	1.822	1.840	1.859	1.877	1.896	1.914	1.933
31		1.687	1.705	1.723	1.741	1.759	1.777	1.795	1.813	1.831	1.848	1.866	1.884	1.902
32		1.665	1.683	1.701	1.718	1.736	1.753	1.770	1.787	1.805	1.822	1.839	1.857	1.874
33		1.646	1.662	1.679	1.696	1.713	1.730	1.747	1.763	1.780	1.797	1.814	1.831	1.848
34		1.627	1.643	1.660	1.676	1.692	1.708	1.725	1.741	1.758	1.774	1.790	1.806	1.823
35		1.609	1.624	1.640	1.656	1.672	1.688	1.704	1.720	1.736	1.752	1.768	1.783	1.799
36		1.592	1.607	1.623	1.638	1.654	1.669	1.685	1.700	1.716	1.731	1.747	1.762	1.777
37		1.576	1.591	1.606	1.621	1.636	1.651	1.666	1.681	1.696	1.711	1.726	1.741	1.756
38		1.561	1.575	1.590	1.601	1.619	1.634	1.649	1.663	1.678	1.692	1.707	1.721	1.736
39		1.547	1.560	1.575	1.589	1.603	1.617	1.632	1.646	1.660	1.674	1.689	1.703	1.717
40		1.533	1.544	1.560	1.574	1.588	1.602	1.616	1.630	1.644	1.658	1.672	1.685	1.699
42		1.508	1.520	1.534	1.547	1.560	1.573	1.587	1.600	1.613	1.626	1.640	1.653	1.666
44		1.484	1.497	1.510	1.522	1.535	1.547	1.560	1.573	1.586	1.598	1.611	1.623	1.636
46		1.463	1.475	1.487	1.499	1.511	1.523	1.536	1.548	1.560	1.572	1.584	1.596	1.608
48		1.444	1.455	1.467	1.479	1.491	1.502	1.514	1.525	1.537	1.548	1.560	1.571	1.583
50		1.426	1.437	1.448	1.459	1.471	1.482	1.493	1.504	1.515	1.526	1.537	1.548	1.560
52		1.410	1.420	1.431	1.442	1.453	1.463	1.474	1.484	1.495	1.506	1.517	1.527	1.538
54		1.394	1.405	1.415	1.425	1.436	1.446	1.457	1.467	1.477	1.487	1.498	1.508	1.518
56		1.380	1.390	1.400	1.410	1.420	1.430	1.440	1.450	1.460	1.470	1.480	1.490	1.500
58		1.368	1.377	1.387	1.396	1.406	1.415	1.425	1.434	1.444	1.453	1.463	1.473	1.483
60		1.356	1.364	1.374	1.383	1.392	1.401	1.411	1.420	1.429	1.438	1.448	1.457	1.466
65		1.328	1.336	1.345	1.353	1.362	1.370	1.379	1.388	1.397	1.405	1.414	1.422	1.431
70		1.304	1.312	1.320	1.328	1.336	1.344	1.352	1.360	1.368	1.376	1.384	1.392	1.400
75		1.285	1.291	1.299	1.306	1.314	1.321	1.336	1.343	1.351	1.359	1.366	1.373	
25		5.814	6.076	6.335	6.603	6.869	7.111	7.412	7.690	7.971	8.251	8.536	8.825	9.116
26		5.702	5.957	6.216	6.477	6.740	7.008	7.276	7.551	7.824	8.101	8.387	8.672	8.956
27		5.597	5.845	6.097	6.356	6.618	6.875	7.152	7.416	7.686	7.963	8.239	8.522	8.803
28		5.493	5.738	5.987	6.244	6.499	6.758	7.020	7.285	7.552	7.827	8.100	8.376	8.654
29		5.396	5.635	5.882	6.132	6.385	6.641	6.897	7.159	7.425	7.693	7.961	8.237	8.509
50		5.296	5.536	5.777	6.024	6.271	6.525	6.779	7.039	7.298	7.561	7.829	8.100	8.370
51		5.207	5.442	5.681	5.923	6.168	6.416	6.668	6.922	7.179	7.441	7.707	7.973	8.211
52		5.121	5.350	5.584	5.823	6.063	6.310	6.559	6.812	7.064	7.323	7.602	7.844	8.111
53		5.032	5.263	5.494	5.729	5.967	6.209	6.453	6.704	6.955	7.208	7.464	7.723	7.984
54		4.950	5.179	5.403	5.636	5.972	6.112	6.352	6.598	6.843	7.350	7.607	7.864	
75		4.871	5.096	5.321	5.550	5.779	6.016	6.254	6.496	6.750	6.987	7.237	7.493	7.719
35		4.795	5.015	5.236	5.163	5.690	5.924	6.157	6.398	6.637	6.883	7.128	7.380	7.635
36		4.722	4.938	5.157	5.300	5.606	5.835	6.068	6.303	6.542	6.783	7.028	7.275	7.525
37		4.650	5.865	5.080	5.302	5.524	5.749	5.977	6.212	6.446	6.687	6.927	7.174	7.419
38		4.580	4.794	5.005	5.223	5.442	5.668	5.892	6.123	6.356	6.593	6.829	7.071	7.316
50		4.515	4.724	4.935	5.119	5.366	5.586	5.809	6.036	6.265	6.498	6.733	6.975	7.216
52		4.387	4.592	4.795	5.004	5.217	5.433	5.649	5.871	6.097	6.325	6.562	6.786	7.023
54		4.270	4.466	4.665	4.870	5.076	5.286	5.500	5.715	5.925	6.157	6.381	6.611	6.840
56		4.158	4.350	4.546	4.744	4.947	5.152	5.357	5.569	5.783	6.001	6.221	6.445	6.671
58		4.052	4.240	4.430	4.622	4.818	5.020	5.222	5.431	5.639	5.853	6.067	6.288	6.507
60		3.953	4.136	4.322	4.512	4.702	4.898	5.097	5.300	5.505	5.713	5.932	6.139	6.351
65		3.857	4.038	4.219	4.403	4.590	4.783	4.978	5.178	5.377	5.579	5.785	5.996	6.207
70		3.771	3.943	4.122	4.303	4.485	4.671	4.862	5.056	5.254	5.454	5.653	5.859	6.068
75		3.686	3.856	4.030	4.207	4.387	4.570	4.756	4.945	5.137	5.332	5.530	5.730	5.933
75		3.602	3.771	3.940	4.115	4.290	4.471	4.652	4.840	5.027	5.220	5.413	5.608	5.806
50		3.525	3.692	3.857	4.027	4.200	4.377	4.554	4.736	4.922	5.111	5.298	5.492	5.689
52		3.552	3.508	3.665	3.828	3.991	4.160	4.329	4.501	4.675	4.856	5.036	5.222	5.407
54		3.520	3.314	3.495	3.648	3.805	3.961	4.126	4.291	4.459	4.630	4.803	4.979	5.157
56		3.505	3.198	3.340	3.488	3.636	3.790	3.943	4.102	4.264	4.426	4.590	4.760	4.932
25		7.697	7.981	8.263	8.544	8.829	9.106	9.391	9.673	9.954	10.23	10.51	10.79	11.07
26		7.654	7.937	8.220	8.503	8.781	9.067	9.348	9.630	9.910	10.19	10.47	10.75	11.03
27		7.611	7.893	8.175	8.458	8.711	9.027	9.306	9.586	9.867	10.15	10.43	10.71	10.99
28		7.567	7.850	8.132	8.144	8.597	8.979	9.260	9.542	9.823	10.10	10.39	10.67	10.95
29		7.525	7.806	8.088	8.371	8.653	8.935	9.215	9.497	9.779	10.06	10.34	10.62	10.90
50		7.482	7.763	8.044	8.338	8.607	8.890	9.171	9.453	9.745	10.02	10.30	10.58	10.86
52		7.439	7.720	3.001	8.283	8.544	8.815	9.137	9.408	9.689	9.971	10.25	10.53	10.81
54		7.397	7.677	7.957	8.239	8.519	8.801	9.083	9.364	9.645	9.926	10.21	10.49	10.77
56		7.351	7.635	7.915	8.196	8.476	8.757	9.038	9.320	9.600	9.881	10.16	10.44	10.72
58		7.312	7.593	7.732	8.152	8.433	8.711	8.991	9.275	9.555	9.836	10.12	10.40	10.68
75		7.271	7.551	7.830	8.110	8.391	8.670	8.950	9.230	9.511	9.791	10.07	10.35	10.63
36		7.230	7.509	7.787	8.067	8.346	8.626	8.905	9.186	9.466	9.747	10.02	10.31	10.59
37		7.190	7.467	7.746	8.024	8.300	8.583	8.862	9.142	9.422	9.702	9.983	10.26	10.54
38		7.149	7.427	7.704	7.983	8.261	8.540	8.818	9.099	9.378	9.658	9.938	10.22	10.50
39		7.109	7.388	7.665	7.941	8.220</								

TABLE 4.- Z-PANEL PROPERTIES $\left[\frac{b_w}{t_8} = 0.79; \frac{b_A}{t_w} = 9.8; \frac{b_F}{t_w} = 0.4; \frac{x_A}{t_w} = 3; \frac{x_F}{t_w} = 4; \frac{d}{t_8} = 1.93; \frac{p}{t_8} = 12.3 \right]$

$\frac{b_w}{t_8}$	20	21	22	23	24	25	26	27	28	29	30	31	32
25	1.858	1.893	1.928	1.963	1.998	2.033	2.068	2.103	2.138	2.172	2.207	2.242	2.277
26	1.825	1.859	1.892	1.926	1.959	1.993	2.027	2.060	2.094	2.127	2.161	2.195	2.228
27	1.794	1.827	1.859	1.891	1.921	1.956	1.989	2.021	2.053	2.086	2.118	2.151	2.183
28	1.766	1.797	1.828	1.860	1.891	1.922	1.953	1.984	2.016	2.047	2.078	2.109	2.140
29	1.740	1.770	1.800	1.830	1.860	1.890	1.920	1.950	1.981	2.011	2.041	2.071	2.101
30	1.715	1.744	1.773	1.803	1.831	1.861	1.890	1.919	1.948	1.977	2.006	2.035	2.064
31	1.692	1.720	1.748	1.776	1.805	1.833	1.861	1.889	1.917	1.946	1.974	2.002	2.030
32	1.670	1.698	1.725	1.752	1.779	1.807	1.834	1.861	1.889	1.916	1.943	1.971	1.998
33	1.650	1.676	1.703	1.729	1.756	1.782	1.809	1.835	1.862	1.888	1.915	1.942	1.968
34	1.631	1.657	1.682	1.708	1.734	1.759	1.785	1.811	1.836	1.862	1.888	1.915	1.939
35	1.613	1.638	1.663	1.688	1.713	1.738	1.763	1.788	1.812	1.837	1.862	1.887	1.912
36	1.596	1.620	1.641	1.669	1.693	1.717	1.741	1.766	1.790	1.814	1.838	1.863	1.887
37	1.580	1.602	1.627	1.650	1.674	1.698	1.721	1.745	1.769	1.792	1.816	1.840	1.863
38	1.564	1.587	1.610	1.633	1.656	1.679	1.702	1.725	1.748	1.771	1.794	1.817	1.840
39	1.550	1.572	1.595	1.617	1.640	1.662	1.684	1.707	1.729	1.752	1.774	1.797	1.819
40	1.536	1.558	1.580	1.602	1.624	1.645	1.667	1.689	1.711	1.733	1.755	1.777	1.798
42	1.521	1.551	1.552	1.573	1.594	1.615	1.635	1.656	1.677	1.698	1.719	1.740	1.760
44	1.487	1.507	1.527	1.547	1.567	1.587	1.607	1.626	1.646	1.666	1.686	1.706	1.726
46	1.466	1.485	1.504	1.523	1.542	1.561	1.580	1.599	1.618	1.637	1.656	1.675	1.694
48	1.447	1.465	1.483	1.503	1.520	1.538	1.556	1.574	1.592	1.611	1.629	1.647	1.665
50	1.429	1.446	1.464	1.481	1.499	1.516	1.534	1.551	1.569	1.588	1.604	1.622	1.639
52	1.412	1.429	1.446	1.463	1.480	1.496	1.513	1.530	1.547	1.561	1.580	1.597	1.614
54	1.397	1.413	1.430	1.446	1.462	1.478	1.494	1.510	1.527	1.543	1.559	1.575	1.591
56	1.383	1.399	1.414	1.430	1.445	1.461	1.477	1.492	1.508	1.523	1.539	1.555	1.570
58	1.370	1.385	1.400	1.415	1.430	1.445	1.460	1.475	1.490	1.505	1.520	1.536	1.551
60	1.357	1.372	1.387	1.403	1.416	1.430	1.445	1.459	1.474	1.489	1.503	1.518	1.532
65	1.330	1.343	1.357	1.370	1.384	1.398	1.411	1.424	1.438	1.451	1.464	1.478	1.491
70	1.306	1.319	1.333	1.344	1.356	1.369	1.381	1.395	1.406	1.419	1.431	1.444	1.456
75	1.286	1.298	1.309	1.321	1.333	1.344	1.356	1.368	1.379	1.391	1.402	1.414	1.426
25	4.313	4.395	4.491	5.264	5.595	5.932	6.274	6.622	6.976	7.337	7.700	8.067	8.439
26	4.233	4.311	4.851	5.170	5.497	5.828	6.165	6.510	6.868	7.213	7.571	7.932	8.302
27	4.156	4.237	4.764	5.080	5.399	5.728	6.059	6.399	6.744	7.091	7.447	7.803	8.167
28	4.081	4.164	4.682	4.990	5.307	5.630	5.959	6.294	6.631	6.977	7.327	7.682	8.042
29	4.010	4.091	4.600	4.906	5.218	5.537	5.862	6.192	6.525	6.866	7.211	7.562	7.917
30	3.912	4.023	4.524	4.825	5.132	5.445	5.765	6.091	6.423	6.759	7.101	7.447	7.798
31	3.876	3.957	4.450	4.747	5.048	5.359	5.674	5.997	6.324	6.654	6.992	7.334	7.681
32	3.814	3.892	4.377	4.671	4.971	5.274	5.586	5.905	6.226	6.555	6.889	7.225	7.568
33	3.752	3.832	4.303	4.598	4.892	5.195	5.501	5.815	6.133	6.459	6.786	7.118	7.458
34	3.691	3.772	4.243	4.527	4.817	5.116	5.419	5.727	6.045	6.361	6.688	7.018	7.355
35	3.637	3.715	4.177	4.458	4.745	5.058	5.358	5.661	5.950	6.274	6.596	6.922	7.254
36	3.582	3.660	4.116	4.392	4.676	4.966	5.263	5.563	5.873	6.185	6.504	6.824	7.152
37	3.529	3.608	4.055	4.330	4.609	4.894	5.188	5.485	5.788	6.099	6.412	6.730	7.056
38	3.480	3.557	3.999	4.268	4.545	4.827	5.116	5.411	5.711	6.016	6.327	6.643	6.964
39	3.430	3.507	3.941	4.208	4.479	4.759	5.016	5.315	5.633	5.933	6.212	6.552	6.870
40	3.383	3.458	3.887	4.149	4.418	4.696	4.977	5.263	5.557	5.855	6.158	6.467	6.761
42	3.329	3.367	3.781	4.039	4.302	4.570	4.810	5.128	5.411	5.706	6.002	6.304	6.614
44	3.207	3.286	3.686	3.922	4.192	4.454	4.722	4.995	5.279	5.565	5.855	6.151	6.451
46	3.126	3.198	3.594	3.838	4.068	4.345	4.608	4.876	5.150	5.430	5.715	6.005	6.299
48	3.050	3.121	3.507	3.766	3.988	4.210	4.497	4.761	5.030	5.301	5.581	5.865	6.155
50	2.979	3.050	3.424	3.658	3.896	4.112	4.392	4.651	4.912	5.182	5.453	5.730	6.015
52	2.912	2.981	3.346	3.574	3.807	4.049	4.295	4.546	4.803	5.065	5.335	5.608	5.885
54	2.848	2.916	3.272	3.495	3.723	3.959	4.201	4.448	4.697	4.955	5.219	5.487	5.760
56	2.786	2.853	3.203	3.419	3.645	3.875	4.109	4.322	4.592	4.852	5.109	5.372	5.610
58	2.729	2.795	3.136	3.319	3.569	3.791	4.026	4.263	4.505	4.752	5.006	5.261	5.521
60	2.675	2.739	3.072	3.282	3.496	3.718	3.913	4.177	4.411	4.655	4.905	5.157	5.417
65	2.549	2.612	2.927	3.126	3.329	3.511	3.755	3.977	4.203	4.436	4.675	4.915	5.163
70	2.437	2.496	2.797	2.985	3.182	3.361	3.568	3.799	4.017	4.237	4.396	4.696	4.934
75	2.336	2.393	2.680	2.860	3.046	3.239	3.435	3.637	3.847	4.058	4.278	4.500	4.726
25	5.454	5.932	6.183	6.516	6.908	7.269	7.629	7.988	8.345	8.702	9.133	9.412	9.765
26	5.124	5.957	6.153	6.516	6.877	7.238	7.597	7.957	8.314	8.572	8.921	9.381	9.736
27	5.295	5.921	6.121	6.484	6.845	7.206	7.565	7.925	8.283	8.440	8.996	9.351	9.705
28	5.395	5.885	6.090	6.451	6.813	7.173	7.533	7.892	8.250	8.407	8.944	9.319	9.674
29	5.334	5.849	6.059	6.420	6.781	7.111	7.501	7.860	8.217	8.575	8.971	9.287	9.612
30	5.305	5.815	6.027	6.388	6.749	7.108	7.467	7.826	8.184	8.512	8.868	9.254	9.610
31	5.275	5.780	5.996	6.357	6.715	7.075	7.434	7.793	8.151	8.476	8.832	9.187	9.543
32	5.245	5.745	5.626	6.325	6.684	7.021	7.401	7.760	8.117	8.441	8.797	9.153	9.509
33	5.216	5.711	5.934	6.293	6.651	7.010	7.368	7.726	8.084	8.411	8.777	9.119	9.475
34	5.187	5.577	5.903	6.261	6.618	6.977	7.335	7.692	8.050	8.407	8.763	9.119	9.475
35	5.158	5.614	5.872	6.229	6.587	6.944	7.301	7.658	8.016	8.373	8.729	9.085	9.441
36	5.130	5.611	5.812	6.198	6.555	6.912	7.269	7.625	7.982	8.339	8.696	9.051	9.407
37	5.102	5.579	5.812	6.168	6.524	6.880	7.236	7.592	7.948	8.305	8.661	9.016	9.372
38	5.074	5.547	5.782	6.137	6.492	6.848	7.203	7.559	7.917	8.271	8.627	8.982	9.337
39	5.046	5.525	5.752	6.106	6.460	6.815	7.171	7.528	7.881	8.236	8.592	8.947	9.302
40	4.998	5.183	5.723	6.075	6.429	6.784	7.138	7.493	7.848	8.203	8.577	8.912	9.268
42	4.965	5.123	5.665	6.016	6.368	6.720	7.074	7.428	7.782	8.135	8.489	8.843	9.198
44	4.913	5.363	5.608	5.957	6.307	6.658	7.009						

TABLE 4.- Z-PANEL PROPERTIES - Concluded
 $\frac{t_w}{t_B} = 0.79; \frac{b_A}{t_w} = 9.8; \frac{b_F}{b_w} = 0.4; \frac{r_A}{t_w} = 3; \frac{r_F}{t_w} = 4; \frac{A}{t_B} = 1.93; \frac{P}{t_B} = 12.3$

$\frac{b_w}{t_B}$	33	34	35	36	37	38	39	40	41	42	43	44	45
25	2.512	2.347	2.382	2.417	2.452	2.487	2.522	2.557	2.592	2.627	2.662	2.697	2.732
26	2.262	2.295	2.329	2.363	2.397	2.430	2.461	2.497	2.531	2.564	2.598	2.631	2.665
27	2.216	2.247	2.280	2.312	2.345	2.377	2.410	2.442	2.474	2.506	2.539	2.571	2.604
28	2.171	2.203	2.234	2.265	2.297	2.328	2.359	2.390	2.422	2.453	2.484	2.515	2.546
29	2.131	2.161	2.191	2.222	2.252	2.282	2.312	2.342	2.372	2.402	2.433	2.463	2.493
30	2.093	2.123	2.152	2.181	2.210	2.239	2.268	2.297	2.327	2.356	2.385	2.414	2.443
31	2.058	2.086	2.115	2.143	2.171	2.199	2.228	2.255	2.284	2.312	2.340	2.368	2.397
32	2.026	2.053	2.080	2.107	2.135	2.162	2.189	2.216	2.242	2.271	2.299	2.326	2.353
33	1.995	2.021	2.048	2.074	2.101	2.127	2.153	2.179	2.206	2.232	2.259	2.285	2.312
34	1.965	1.991	2.017	2.042	2.068	2.093	2.119	2.145	2.171	2.196	2.222	2.248	2.274
35	1.937	1.962	1.987	2.012	2.037	2.062	2.087	2.112	2.137	2.162	2.187	2.212	2.237
36	1.912	1.936	1.960	1.984	2.009	2.033	2.057	2.081	2.106	2.130	2.154	2.178	2.203
37	1.887	1.910	1.934	1.957	1.981	2.005	2.029	2.052	2.076	2.099	2.123	2.146	2.170
38	1.863	1.886	1.906	1.932	1.955	1.978	2.001	2.024	2.047	2.070	2.093	2.116	2.139
39	1.842	1.864	1.886	1.908	1.931	1.953	1.976	1.998	2.021	2.043	2.066	2.088	2.110
40	1.820	1.842	1.864	1.886	1.908	1.929	1.951	1.973	1.995	2.017	2.039	2.060	2.082
41	1.781	1.802	1.823	1.844	1.865	1.885	1.906	1.927	1.948	1.966	1.989	2.010	2.031
42	1.746	1.765	1.785	1.805	1.825	1.845	1.865	1.885	1.905	1.924	1.944	1.964	1.984
43	1.713	1.732	1.751	1.770	1.789	1.808	1.827	1.846	1.865	1.884	1.903	1.922	1.941
44	1.683	1.702	1.720	1.738	1.756	1.771	1.793	1.811	1.829	1.847	1.866	1.884	1.902
45	1.657	1.674	1.692	1.709	1.726	1.742	1.761	1.778	1.796	1.813	1.831	1.848	1.866
46	1.631	1.648	1.665	1.681	1.698	1.715	1.732	1.748	1.765	1.782	1.799	1.816	1.833
47	1.607	1.624	1.640	1.656	1.672	1.688	1.705	1.721	1.737	1.753	1.770	1.786	1.802
48	1.586	1.601	1.617	1.633	1.649	1.664	1.680	1.695	1.711	1.726	1.742	1.757	1.773
49	1.567	1.581	1.596	1.611	1.626	1.641	1.656	1.671	1.686	1.701	1.716	1.731	1.746
50	1.547	1.561	1.576	1.590	1.605	1.620	1.635	1.649	1.664	1.678	1.693	1.707	1.722
51	1.505	1.518	1.532	1.545	1.559	1.572	1.586	1.599	1.613	1.626	1.640	1.653	1.666
52	1.469	1.481	1.494	1.506	1.519	1.531	1.544	1.556	1.569	1.581	1.594	1.606	1.619
53	1.438	1.449	1.461	1.472	1.484	1.496	1.508	1.519	1.531	1.542	1.554	1.566	1.578
55	8.815	9.195	9.578	9.965	10.36	10.75	11.15	11.55	11.95	12.35	12.75	13.17	13.59
56	8.672	9.050	9.448	9.809	10.19	10.59	10.98	11.38	11.77	12.18	12.58	12.99	13.40
57	8.532	8.909	9.282	9.662	10.04	10.43	10.82	11.21	11.61	12.01	12.40	12.81	13.21
58	8.406	8.770	9.142	9.518	9.893	10.28	10.66	11.05	11.44	11.84	12.23	12.63	13.04
59	8.277	8.611	9.008	9.376	9.751	10.13	10.51	10.90	11.29	11.68	12.07	12.46	12.86
59	8.154	8.510	8.873	9.241	9.612	9.987	10.37	10.73	11.13	11.52	11.91	12.30	12.70
60	8.033	8.389	8.745	9.109	9.477	9.848	10.22	10.60	10.98	11.36	11.75	12.14	12.53
61	7.913	8.265	8.622	8.983	9.343	9.711	10.08	10.46	10.84	11.21	11.59	11.98	12.37
62	7.800	8.119	8.499	8.856	9.213	9.579	9.948	10.32	10.69	11.07	11.45	11.83	12.22
63	7.691	8.036	8.383	8.738	9.092	9.455	9.817	10.18	10.55	10.93	11.30	11.68	12.06
60	7.569	7.929	8.274	8.622	8.974	9.330	9.690	10.05	10.42	10.79	11.16	11.54	11.92
61	7.442	7.819	8.161	8.507	8.855	9.207	9.564	9.926	10.29	10.65	11.02	11.40	11.77
62	7.383	7.719	8.055	8.399	8.742	9.090	9.441	9.800	10.16	10.52	10.89	11.26	11.63
63	7.289	7.619	7.953	8.291	8.633	8.979	9.328	9.681	10.04	10.40	10.76	11.13	11.50
64	7.190	7.518	7.850	8.184	8.522	8.867	9.210	9.562	9.913	10.27	10.63	10.99	11.36
65	7.102	7.124	7.751	8.081	8.416	8.759	9.102	9.448	9.797	10.15	10.51	10.87	11.23
66	6.925	7.211	7.551	7.885	8.214	8.549	8.885	9.225	9.558	9.919	10.27	10.62	10.98
67	6.756	7.070	7.384	7.702	8.034	8.350	8.680	9.014	9.351	9.697	10.01	10.39	10.74
68	6.599	6.903	7.212	7.521	7.841	8.162	8.487	8.815	9.118	9.453	9.823	10.17	10.51
69	6.449	6.715	7.048	7.356	7.668	7.984	8.300	8.623	8.951	9.282	9.612	9.950	10.29
69	6.301	6.595	6.890	7.193	7.501	7.812	8.124	8.443	8.762	9.089	9.414	9.748	10.08
70	6.167	6.153	6.744	7.043	7.342	7.646	7.953	8.269	8.584	8.902	9.221	9.549	9.878
71	6.038	6.317	6.604	6.896	7.192	7.491	7.793	8.098	8.410	8.725	9.038	9.360	9.686
72	5.913	6.156	6.150	6.751	7.042	7.339	7.635	7.939	8.213	8.555	8.866	9.185	9.503
73	5.788	6.063	6.310	6.621	6.906	7.196	7.489	7.786	8.087	8.392	8.700	9.012	9.327
70	5.678	5.947	6.217	6.495	6.774	7.056	7.320	7.591	7.807	8.233	8.534	8.844	9.151
71	5.413	5.670	5.929	6.195	6.462	6.737	7.011	7.294	7.576	7.866	8.156	8.453	8.754
72	5.174	5.421	5.669	5.925	6.182	6.446	6.711	6.983	7.255	7.525	7.811	8.101	8.387
73	4.956	5.194	5.434	5.681	5.928	6.180	6.435	6.698	6.961	7.232	7.502	7.776	8.052
75	10.12	10.47	10.82	11.17	11.51	11.86	12.21	12.55	12.89	13.23	13.57	13.91	14.25
76	10.19	10.44	10.79	11.14	11.49	11.83	12.16	12.53	12.87	13.21	13.56	13.90	14.24
77	10.06	10.41	10.76	11.11	11.46	11.81	12.16	12.50	12.85	13.19	13.53	13.88	14.22
78	10.03	10.38	10.73	11.08	11.43	11.78	12.13	12.48	12.82	13.17	13.51	13.85	14.20
79	9.926	10.35	10.70	11.05	11.40	11.75	12.10	12.45	12.80	13.14	13.49	13.83	14.17
79	9.964	10.32	10.67	11.02	11.37	11.72	12.07	12.42	12.77	13.11	13.46	13.81	14.15
80	9.931	10.29	10.64	10.99	11.34	11.69	12.04	12.39	12.74	13.09	13.43	13.78	14.12
81	9.887	10.25	10.61	10.96	11.31	11.66	12.01	12.36	12.71	13.06	13.40	13.75	14.10
82	9.841	10.22	10.57	10.93	11.27	11.63	11.98	12.33	12.68	13.03	13.38	13.72	14.07
83	9.820	10.18	10.51	10.89	11.24	11.60	11.95	12.30	12.65	13.00	13.35	13.69	14.04
80	9.796	10.15	10.50	10.86	11.21	11.56	11.92	12.27	12.62	12.97	13.31	13.66	14.01
81	9.761	10.12	10.47	10.82	11.18	11.53	11.88	12.23	12.58	12.93	13.28	13.63	13.98
82	9.727	10.08	10.44	10.79	11.14	11.50	11.85	12.20	12.55	12.90	13.25	13.60	13.95
83	9.693	10.05	10.40	10.76	11.11	11.46	11.81	12.17	12.52	12.87	13.21	13.57	13.92
84	9.657	10.01	10.37	10.72	11.07	11.43	11.78	12.13	12.48	12.81	13.19	13.54	13.89
84	9.623	9.977	10.32	10.69	11.04	11.39	11.75	12.10	12.47	12.80	13.14	13.50	13.85
85	9.553	9.907	10.26	10.61	10.97	11.32	11.68	12.03	12.38	12.73	13.08	13.43	13.79
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TABLE 5.- Z-PANEL PROPERTIES $\left[\frac{t_w}{t_g} = 1.00; \frac{b_A}{t_w} = 8.6; \frac{b_p}{t_w} = 0.4; \frac{r_A}{t_w} = 3; \frac{r_p}{t_w} = 4; \frac{d}{t_g} = 1.95; \frac{p}{t_g} = 11.7 \right]$

$\frac{b_g}{t_g}$	20	21	22	23	24	25	26	27	28	29	30	31	32
25	2.327	2.383	2.439	2.495	2.551	2.607	2.663	2.719	2.775	2.831	2.887	2.943	2.999
26	2.276	2.330	2.383	2.437	2.491	2.545	2.599	2.653	2.706	2.760	2.814	2.868	2.922
27	2.228	2.280	2.332	2.384	2.436	2.488	2.540	2.591	2.643	2.695	2.747	2.799	2.851
28	2.195	2.235	2.285	2.335	2.385	2.435	2.485	2.535	2.585	2.635	2.685	2.735	2.785
29	2.144	2.192	2.240	2.289	2.337	2.385	2.433	2.482	2.530	2.578	2.626	2.675	2.723
30	2.106	2.152	2.199	2.246	2.292	2.339	2.396	2.442	2.479	2.526	2.572	2.619	2.666
31	2.070	2.115	2.160	2.205	2.251	2.296	2.341	2.386	2.432	2.476	2.522	2.567	2.612
32	2.036	2.080	2.124	2.168	2.211	2.255	2.299	2.343	2.386	2.430	2.474	2.517	2.561
33	2.005	2.048	2.090	2.132	2.175	2.217	2.260	2.302	2.344	2.387	2.429	2.472	2.514
34	1.975	2.017	2.058	2.099	2.140	2.181	2.223	2.261	2.305	2.346	2.387	2.429	2.470
35	1.948	1.988	2.023	2.068	2.108	2.148	2.188	2.228	2.268	2.308	2.348	2.388	2.428
36	1.921	1.960	1.992	2.038	2.077	2.116	2.155	2.194	2.232	2.271	2.310	2.349	2.388
37	1.896	1.934	1.972	2.010	2.048	2.086	2.123	2.161	2.199	2.237	2.275	2.313	2.350
38	1.873	1.910	1.946	1.983	2.020	2.057	2.094	2.131	2.168	2.201	2.241	2.278	2.315
39	1.850	1.886	1.922	1.958	1.994	2.030	2.066	2.102	2.138	2.174	2.209	2.245	2.281
40	1.829	1.864	1.899	1.934	1.969	2.004	2.039	2.074	2.109	2.144	2.179	2.214	2.249
41	1.790	1.823	1.856	1.890	1.925	1.956	1.990	2.023	2.056	2.090	2.123	2.157	2.190
42	1.754	1.786	1.817	1.849	1.881	1.913	1.945	1.976	2.008	2.040	2.072	2.104	2.136
43	1.721	1.751	1.782	1.812	1.843	1.873	1.904	1.934	1.964	1.995	2.025	2.056	2.086
44	1.691	1.720	1.749	1.778	1.808	1.837	1.866	1.895	1.924	1.953	1.983	2.012	2.041
45	1.663	1.691	1.719	1.747	1.775	1.803	1.831	1.859	1.887	1.912	1.943	1.971	1.999
46	1.635	1.665	1.692	1.719	1.746	1.772	1.799	1.826	1.852	1.880	1.907	1.934	1.961
47	1.614	1.640	1.666	1.692	1.718	1.744	1.770	1.796	1.822	1.848	1.873	1.899	1.925
48	1.592	1.617	1.642	1.667	1.692	1.717	1.742	1.767	1.792	1.817	1.842	1.867	1.892
49	1.572	1.596	1.620	1.644	1.668	1.693	1.717	1.741	1.765	1.789	1.813	1.837	1.861
50	1.553	1.576	1.599	1.623	1.646	1.668	1.693	1.716	1.739	1.763	1.786	1.810	1.833
51	1.510	1.532	1.553	1.575	1.596	1.618	1.639	1.661	1.683	1.704	1.726	1.748	1.769
52	1.474	1.494	1.514	1.534	1.554	1.574	1.594	1.614	1.634	1.654	1.674	1.694	1.714
53	1.442	1.461	1.480	1.498	1.517	1.536	1.554	1.573	1.592	1.610	1.629	1.648	1.666
54	6.576	7.044	7.519	8.002	8.493	8.990	9.493	10.00	10.52	11.03	11.56	12.09	12.62
55	6.473	6.935	7.408	7.886	8.371	8.862	9.360	9.863	10.38	10.89	11.41	11.93	12.46
56	6.376	6.833	7.298	7.770	8.250	8.737	9.230	9.732	10.24	10.75	11.26	11.78	12.30
57	6.278	6.729	7.190	7.658	8.133	8.615	9.104	9.599	10.10	10.61	11.12	11.63	12.15
58	6.185	6.632	7.089	7.550	8.021	8.500	8.985	9.472	9.970	10.47	10.98	11.49	12.01
59	6.095	6.529	6.988	7.447	7.911	8.385	8.864	9.352	9.843	10.34	10.84	11.35	11.86
60	6.008	6.446	6.892	7.346	7.805	8.274	8.750	9.232	9.716	10.21	10.71	11.21	11.72
61	5.926	6.357	6.797	7.216	7.705	8.168	8.638	9.114	9.600	10.09	10.58	11.08	11.59
62	5.842	6.268	6.706	7.152	7.602	8.063	8.527	9.003	9.483	9.965	10.46	10.95	11.45
63	5.761	6.185	6.617	7.057	7.506	7.962	8.421	8.890	9.366	9.848	10.32	10.82	11.32
64	5.684	6.105	6.530	6.966	7.409	7.860	8.318	8.782	9.253	9.730	10.21	10.70	11.19
65	5.611	6.025	6.448	6.879	7.317	7.761	8.217	8.677	9.147	9.620	10.10	10.58	11.07
66	5.539	5.948	6.366	6.793	7.227	7.669	8.122	8.578	9.040	9.508	9.982	10.46	10.95
67	5.466	5.871	6.288	6.711	7.111	7.579	8.024	8.476	8.941	9.402	9.873	10.35	10.83
68	5.399	5.800	6.210	6.628	7.055	7.489	7.930	8.378	8.853	9.294	9.765	10.24	10.71
69	5.332	5.729	6.135	6.549	6.972	7.403	7.840	8.285	8.736	9.194	9.657	10.13	10.60
70	5.202	5.592	5.991	6.395	6.811	7.235	7.663	8.101	8.517	8.954	9.451	9.910	10.38
71	5.080	5.461	5.854	6.252	6.659	7.074	7.500	7.929	8.341	8.807	9.255	9.709	10.17
72	4.965	5.340	5.721	6.115	6.513	6.922	7.335	7.760	8.191	8.625	9.069	9.511	9.970
73	4.855	5.222	5.593	5.974	6.374	6.775	7.184	7.600	8.024	8.454	8.885	9.328	9.775
74	4.751	5.111	5.480	5.858	6.244	6.638	7.040	7.449	7.864	8.287	8.716	9.151	9.592
75	4.650	5.003	5.365	5.735	6.114	6.505	6.900	7.302	7.711	8.127	8.519	8.977	9.411
76	4.556	4.902	5.258	5.622	5.995	6.375	6.764	7.159	7.562	7.971	8.392	8.814	9.212
77	4.465	4.805	5.155	5.512	5.880	6.255	6.637	7.027	7.424	7.828	8.238	8.654	9.077
78	4.377	4.711	5.055	5.408	5.769	6.135	6.513	6.896	7.287	7.686	8.090	8.502	8.919
79	4.293	4.623	4.961	5.306	5.662	6.026	6.394	6.773	7.159	7.588	8.018	8.350	8.762
80	4.101	4.115	4.710	5.071	5.414	5.761	6.120	6.482	6.851	7.232	7.614	8.003	8.403
81	3.926	4.228	4.539	4.858	5.185	5.522	5.865	6.217	6.575	6.940	7.311	7.689	8.074
82	3.768	4.058	4.356	4.665	5.030	5.337	5.974	6.319	6.677	7.057	7.439	7.803	8.173
83	7.258	7.720	8.178	8.631	9.086	9.535	9.982	10.43	10.87	11.31	11.74	12.18	12.61
84	7.239	7.701	8.161	8.616	9.069	9.519	9.967	10.41	10.85	11.29	11.73	12.17	12.60
85	7.219	7.682	8.141	8.598	9.051	9.502	9.950	10.40	10.84	11.28	11.72	12.16	12.59
86	7.199	7.661	8.121	8.578	9.032	9.481	9.933	10.38	10.82	11.27	11.71	12.14	12.58
87	7.178	7.641	8.101	8.558	9.013	9.465	9.915	10.36	10.80	11.25	11.69	12.13	12.57
88	7.156	7.619	8.079	8.537	8.992	9.445	9.936	10.34	10.79	11.23	11.66	12.12	12.55
89	7.134	7.597	8.058	8.516	8.971	9.423	9.876	10.33	10.77	11.22	11.66	12.10	12.54
90	7.111	7.574	8.035	8.493	8.949	9.404	9.855	10.30	10.75	11.20	11.64	12.08	12.52
91	7.088	7.551	8.012	8.471	8.926	9.381	9.833	10.28	10.73	11.18	11.62	12.07	12.51
92	7.066	7.527	7.989	8.447	8.904	9.359	9.811	10.26	10.71	11.16	11.60	12.05	12.49
93	7.041	7.504	7.965	8.423	8.880	9.335	9.788	10.21	10.69	11.14	11.58	12.03	12.47
94	7.019	7.480	7.941	8.400	8.856	9.311	9.765	10.22	10.67	11.12	11.56	12.01	12.45
95	6.994	7.457	7.917	8.375	8.832	9.237	9.742	10.19	10.64	11.09	11.54	11.99	12.43
96	6.970	7.432	7.893	8.351	8.807	9.263	9.717	10.17	10.62	11.07	11.52	11.96	12.41

TABLE 5.- Z-PANEL PROPERTIES - Concluded
 $\frac{t_w}{t_s} = 1.00; \frac{b_A}{t_w} = 8.6; \frac{b_T}{t_w} = 0.4; \frac{r_A}{t_w} = 3; \frac{r_T}{t_w} = 4; \frac{d}{t_B} = 1.95; \frac{P}{t_s} = 11.7$

$\frac{b_w}{t_B}$	33	34	35	36	37	38	39	40	41	42	43	44	45
25	3.055	3.111	3.167	3.223	3.279	3.335	3.391	3.447	3.503	3.559	3.615	3.671	3.727
26	2.976	3.030	3.081	3.137	3.191	3.245	3.299	3.353	3.407	3.460	3.514	3.568	3.622
27	2.903	2.954	3.006	3.058	3.110	3.162	3.214	3.265	3.317	3.369	3.421	3.473	3.525
28	2.835	2.885	2.935	2.985	3.035	3.085	3.135	3.185	3.235	3.285	3.335	3.385	3.435
29	2.773	2.820	2.863	2.916	2.965	3.013	3.061	3.109	3.158	3.206	3.256	3.302	3.351
30	2.713	2.759	2.806	2.852	2.890	2.946	2.993	3.039	3.086	3.132	3.179	3.226	3.273
31	2.656	2.702	2.747	2.792	2.838	2.883	2.928	2.973	3.018	3.063	3.109	3.154	3.199
32	2.604	2.649	2.693	2.736	2.780	2.824	2.868	2.911	2.955	2.999	3.043	3.086	3.130
33	2.557	2.599	2.642	2.684	2.727	2.769	2.811	2.854	2.896	2.938	2.981	3.023	3.066
34	2.512	2.552	2.593	2.631	2.676	2.717	2.758	2.799	2.840	2.881	2.923	2.964	3.005
35	2.468	2.508	2.548	2.588	2.628	2.668	2.708	2.748	2.788	2.823	2.868	2.908	2.948
36	2.427	2.466	2.505	2.544	2.583	2.621	2.660	2.699	2.738	2.777	2.816	2.855	2.894
37	2.388	2.426	2.464	2.502	2.540	2.578	2.616	2.653	2.691	2.729	2.767	2.805	2.843
38	2.352	2.389	2.426	2.462	2.499	2.536	2.573	2.610	2.647	2.685	2.720	2.757	2.794
39	2.317	2.353	2.389	2.425	2.461	2.497	2.533	2.568	2.604	2.640	2.676	2.712	2.748
40	2.284	2.319	2.354	2.389	2.424	2.459	2.494	2.529	2.564	2.599	2.631	2.669	2.704
41	2.221	2.256	2.290	2.323	2.357	2.390	2.423	2.456	2.490	2.523	2.557	2.590	2.623
42	2.168	2.199	2.231	2.263	2.295	2.327	2.359	2.390	2.422	2.454	2.486	2.517	2.549
43	2.117	2.147	2.178	2.208	2.239	2.269	2.300	2.330	2.361	2.391	2.421	2.451	2.482
44	2.070	2.099	2.129	2.158	2.187	2.216	2.245	2.274	2.304	2.333	2.362	2.391	2.420
50	2.027	2.055	2.083	2.111	2.139	2.167	2.195	2.223	2.251	2.279	2.307	2.335	2.362
52	1.988	2.015	2.042	2.069	2.096	2.122	2.149	2.176	2.203	2.230	2.257	2.284	2.311
54	1.951	1.977	2.003	2.029	2.055	2.081	2.107	2.133	2.160	2.185	2.211	2.236	2.262
56	1.917	1.942	1.967	1.992	2.017	2.042	2.067	2.092	2.117	2.142	2.168	2.192	2.217
58	1.885	1.910	1.934	1.958	1.982	2.006	2.031	2.055	2.079	2.103	2.127	2.151	2.175
60	1.857	1.879	1.903	1.926	1.950	1.973	1.997	2.020	2.043	2.066	2.090	2.113	2.137
65	1.791	1.812	1.834	1.855	1.877	1.898	1.920	1.941	1.963	1.984	2.006	2.027	2.049
70	1.731	1.754	1.774	1.794	1.814	1.834	1.854	1.874	1.894	1.914	1.934	1.951	1.974
75	1.685	1.704	1.723	1.741	1.758	1.778	1.796	1.816	1.835	1.853	1.872	1.890	1.909
25	13.16	13.70	14.24	14.79	15.34	15.89	16.45	17.01	17.57	18.14	18.71	19.28	19.85
26	12.99	13.53	14.07	14.62	15.16	15.71	16.27	16.82	17.38	17.95	18.51	19.07	19.64
27	12.83	13.37	13.91	14.44	14.99	15.53	16.08	16.64	17.20	17.75	18.31	18.88	19.44
28	12.68	13.21	13.74	14.28	14.82	15.36	15.91	16.45	17.01	17.56	18.12	18.68	19.21
29	12.52	13.05	13.58	14.12	14.65	15.19	15.73	16.28	16.77	17.38	17.94	18.49	19.05
30	12.38	12.90	13.42	13.96	14.49	15.02	15.56	16.11	16.62	17.20	17.75	18.30	18.86
31	12.24	12.75	13.28	13.80	14.32	14.86	15.40	15.94	16.48	17.03	17.57	18.12	18.68
32	12.10	12.61	13.15	13.65	14.18	14.70	15.23	15.77	16.31	16.85	17.40	17.95	18.50
33	11.96	12.47	12.98	13.50	14.02	14.55	15.08	15.61	16.15	16.69	17.23	17.77	18.32
34	11.82	12.33	12.81	13.36	13.87	14.39	14.92	15.45	15.98	16.52	17.06	17.60	18.14
35	11.69	12.19	12.70	13.21	13.73	14.24	14.77	15.29	15.82	16.36	16.89	17.43	17.97
36	11.56	12.08	12.56	13.07	13.58	14.10	14.62	15.14	15.67	16.20	16.73	17.27	17.80
37	11.44	11.94	12.43	12.94	13.44	13.96	14.47	15.00	15.52	16.04	16.57	17.10	17.64
38	11.32	11.81	12.30	12.81	13.31	13.82	14.33	14.85	15.39	15.89	16.42	16.95	17.48
39	11.20	11.69	12.18	12.67	13.18	13.68	14.19	14.71	15.22	15.74	16.27	16.79	17.32
40	11.08	11.57	12.05	12.55	13.05	13.55	14.06	14.57	15.08	15.60	16.12	16.64	17.17
42	10.85	11.33	11.81	12.30	12.79	13.29	13.79	14.29	14.80	15.31	15.82	16.34	16.86
44	10.63	11.11	11.58	12.06	12.55	13.04	13.52	14.03	14.53	15.05	15.54	16.06	16.57
46	10.43	10.89	11.36	11.84	12.31	12.80	13.28	13.78	14.27	14.77	15.27	15.78	16.29
48	10.23	10.69	11.15	11.62	12.09	12.57	13.05	13.51	14.02	14.51	15.01	15.51	16.02
50	10.04	10.49	10.95	11.41	11.87	12.35	12.82	13.30	13.78	14.27	14.76	15.26	15.79
52	9.851	10.30	10.75	11.20	11.66	12.13	12.60	13.07	13.55	14.03	14.52	15.01	15.50
54	9.675	10.11	10.56	11.01	11.46	11.92	12.39	12.85	13.32	13.80	14.28	14.77	15.26
56	9.505	9.938	10.38	10.82	11.27	11.72	12.18	12.65	13.11	13.58	14.05	14.54	15.02
58	9.342	9.766	10.20	10.64	11.08	11.53	11.98	12.44	12.90	13.37	13.84	14.31	14.79
60	9.176	9.605	10.03	10.46	10.90	11.34	11.79	12.23	12.70	13.16	13.62	14.09	14.56
65	8.803	9.215	9.627	10.05	10.47	10.90	11.34	11.78	12.22	12.67	13.12	13.58	14.00
70	8.434	8.860	9.261	9.668	10.08	10.50	10.92	11.35	11.78	12.21	12.65	13.10	13.55
75	8.119	8.531	8.919	9.318	9.727	10.13	10.54	10.95	11.36	11.79	12.22	12.66	13.09
25	13.04	13.16	13.80	14.31	14.73	15.15	15.57	15.99	16.40	16.81	17.22	17.63	18.04
26	13.03	13.16	13.83	14.31	14.75	15.15	15.57	15.99	16.41	16.82	17.23	17.64	18.05
27	13.02	13.15	13.88	14.31	14.73	15.15	15.57	15.99	16.41	16.83	17.24	17.65	18.06
28	13.01	13.15	13.87	14.30	14.73	15.15	15.57	15.99	16.41	16.83	17.25	17.66	18.07
29	13.00	13.14	13.87	14.30	14.72	15.15	15.57	15.99	16.41	16.83	17.25	17.66	18.08
30	12.99	13.12	13.86	14.29	14.71	15.14	15.57	15.99	16.41	16.83	17.25	17.67	18.09
31	12.98	13.11	13.85	14.28	14.71	15.13	15.56	15.98	16.41	16.83	17.25	17.67	18.08
32	12.96	13.10	13.83	14.27	14.70	15.12	15.55	15.98	16.40	16.82	17.25	17.67	18.08
33	12.95	13.15	13.82	14.25	14.68	15.11	15.54	15.97	16.40	16.82	17.24	17.66	18.08
34	12.93	13.17	13.80	14.24	14.67	15.10	15.53	15.96	16.39	16.81	17.21	17.66	18.08
35	12.91	13.35	13.79	14.22	14.66	15.09	15.52	15.95	16.38	16.80	17.23	17.65	18.07
36	12.89	13.33	13.77	14.21	14.64	15.08	15.51	15.94	16.37	16.80	17.22	17.64	18.07
37	12.87	13.31	13.75	14.19	14.63	15.06	15.49	15.92	16.35	16.78	17.21	17.63	18.06
38	12.85	13.29	13.73	14.17	14.61	15.04	15.48	15.91	16.34	16.77	17.20	17.62	18.05
39	12.83	13.27	13.71	14.15	14.59	15.03	15.46	15.89	16.33	16.76	17.19	17.61	18.04
40	12.81	13.25	13.69	14.13	14.57	15.01	15.44	15.88	16.31	16.74	17.17	17.60	18.03
42	12.76	13.21	13.65	14.09	14.53	14.97	15.41	15.84	16.23	16.71	17.16	17.57	18.00
44	12.71	13.16	13.60	14.05	14.49	14.92	15.37	15.80</					



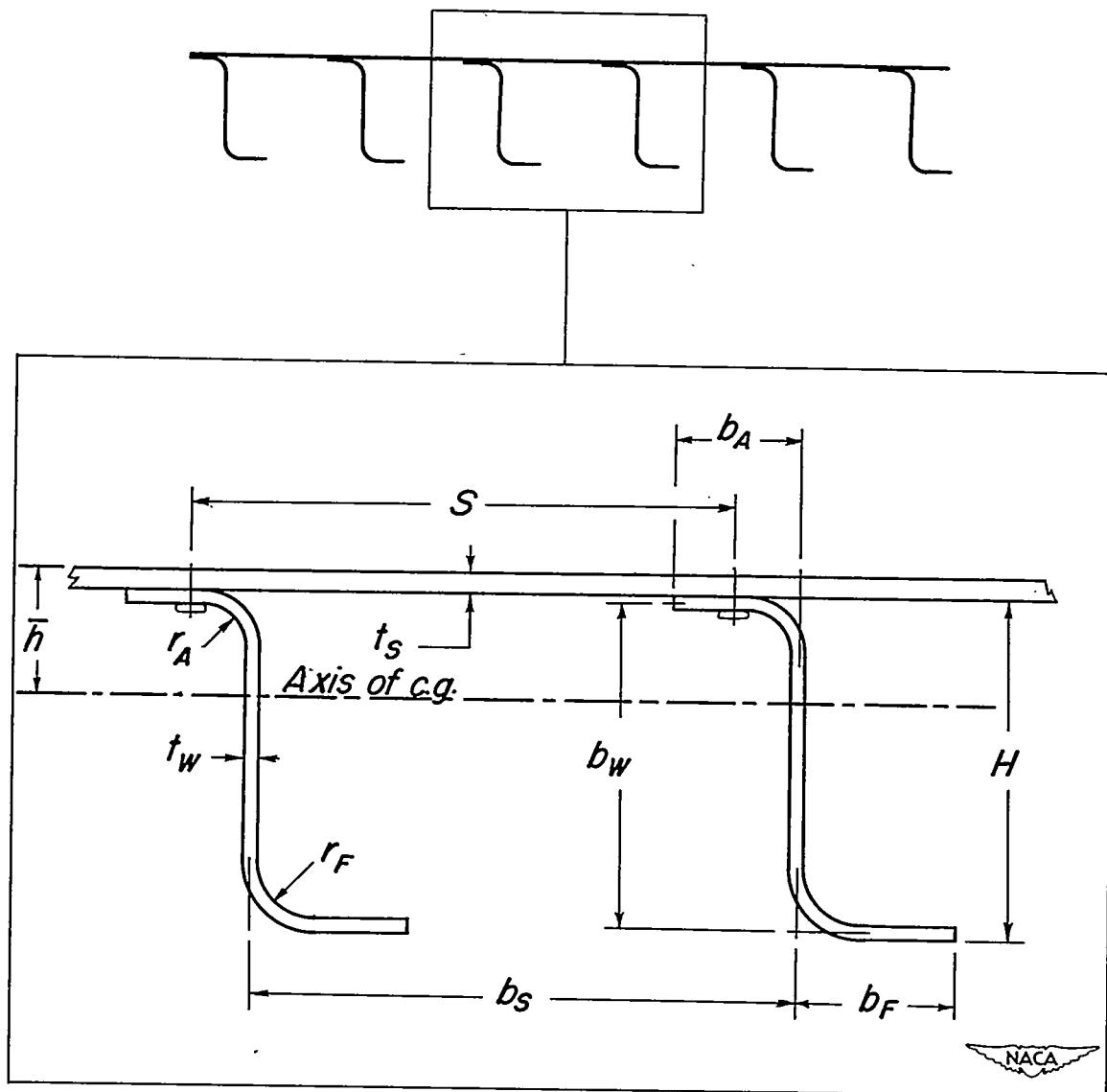


Figure 1. - Symbols for panel dimensions.

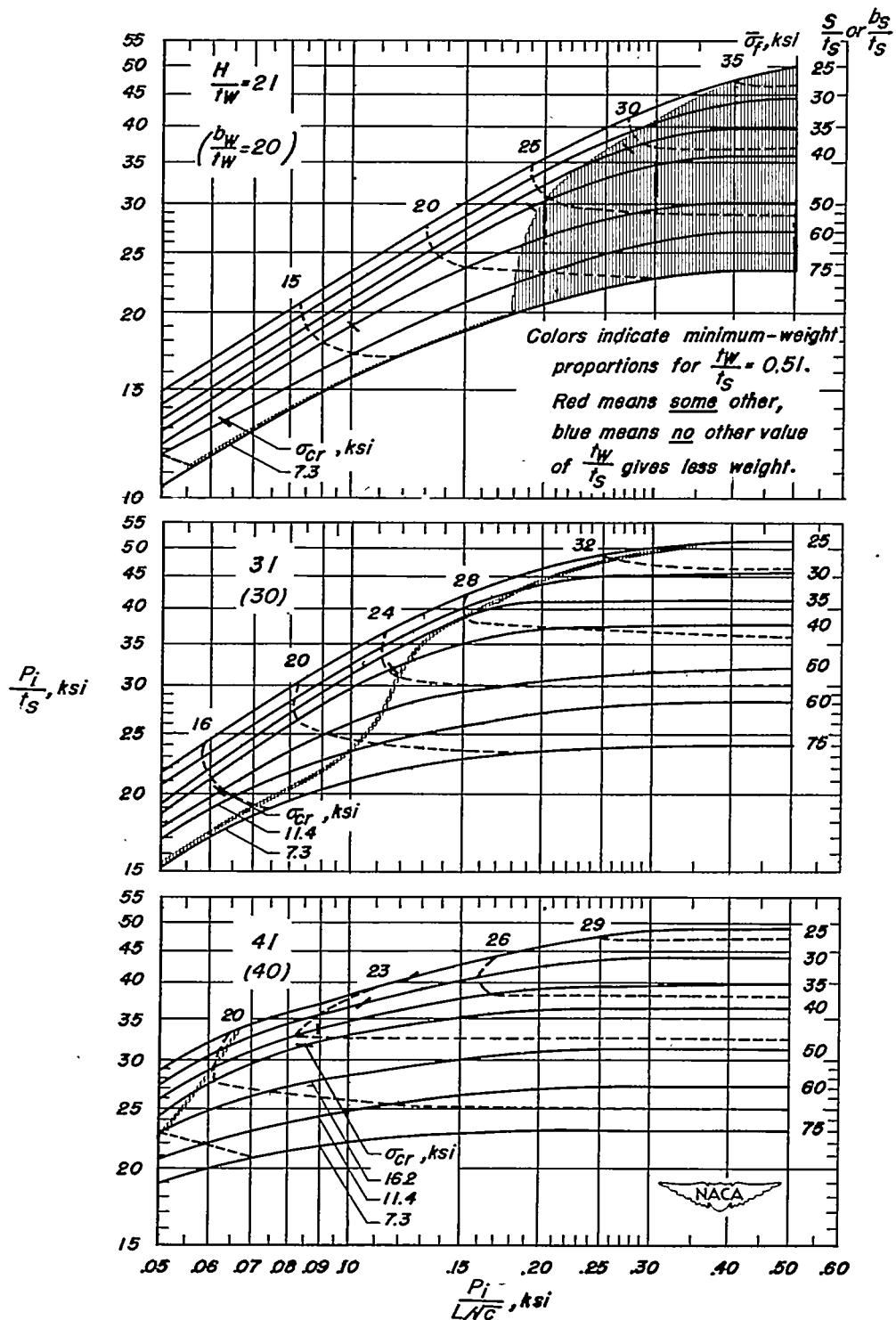
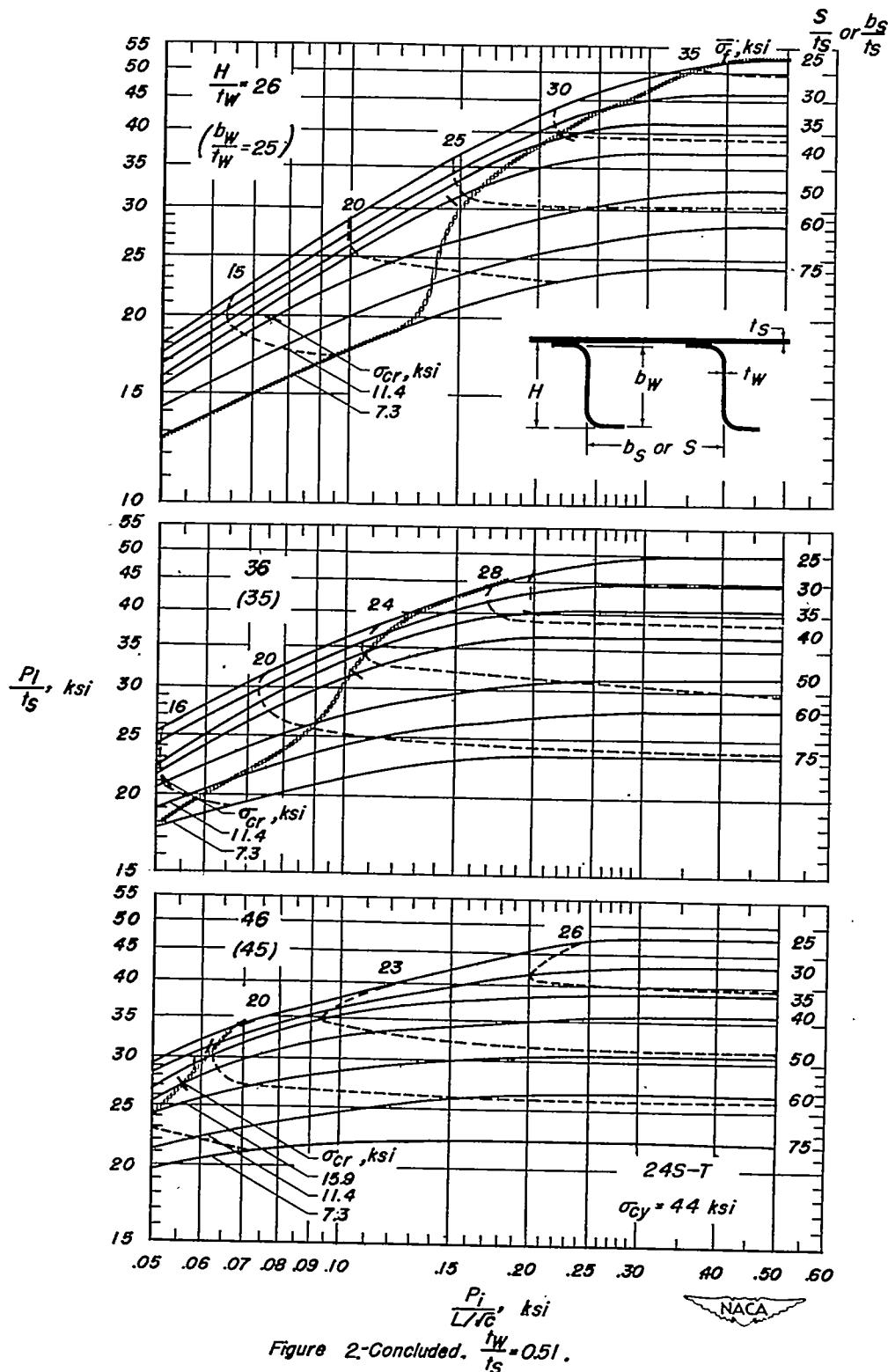


Figure 2. Direct-reading design charts for 24S-T aluminum-alloy Z-stiffened panels. $\frac{t_w}{t_s} = 0.51$.

Figure 2-Concluded. $\frac{t_w}{t_s} = 0.51$.

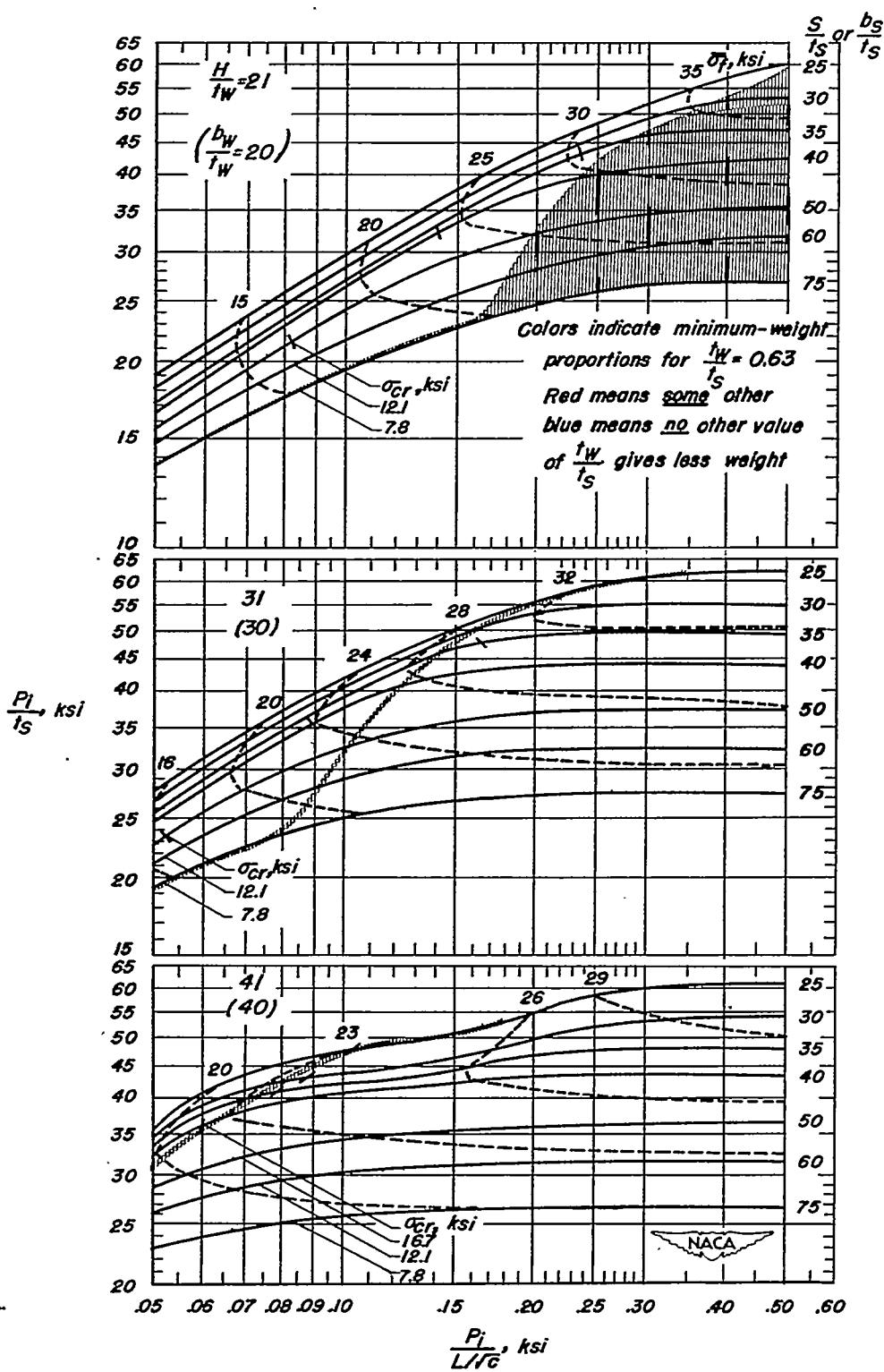
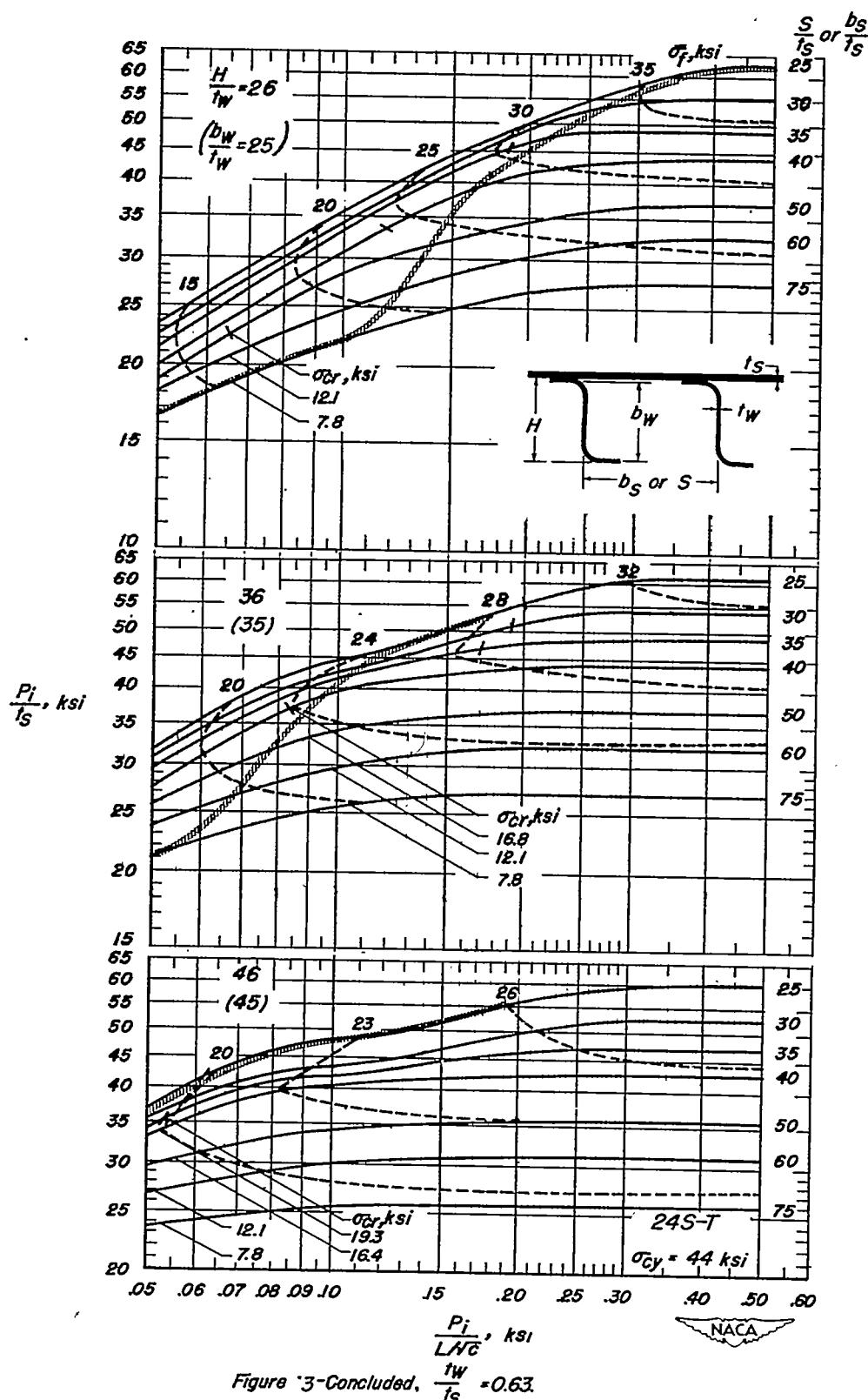


Figure 3-Direct-reading design chart for 24S-T aluminum-alloy Z-stiffened panels. $\frac{t_w}{t_s} = 0.63$.

Figure 3-Concluded, $t_w/t_s = 0.63$.

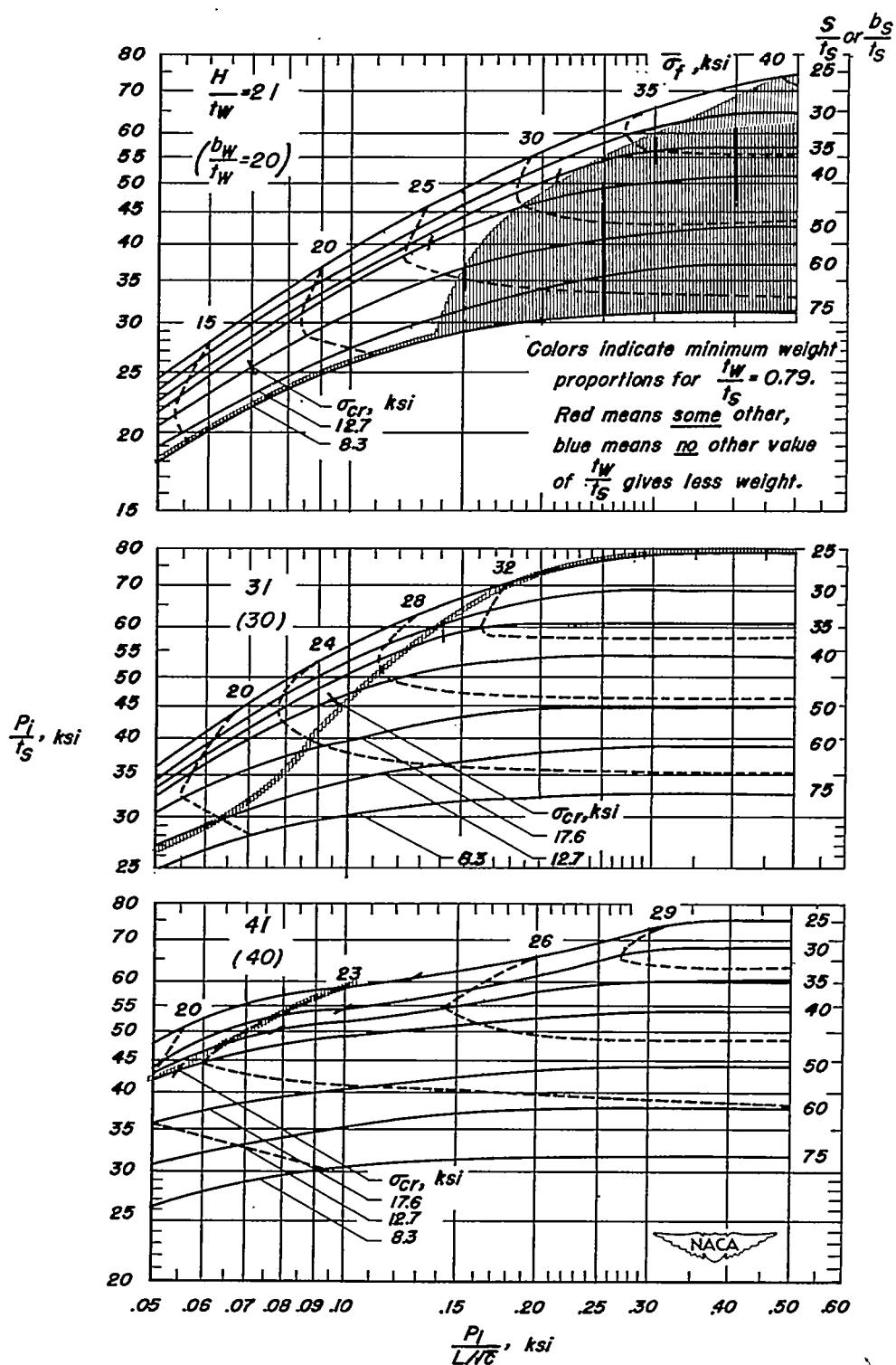
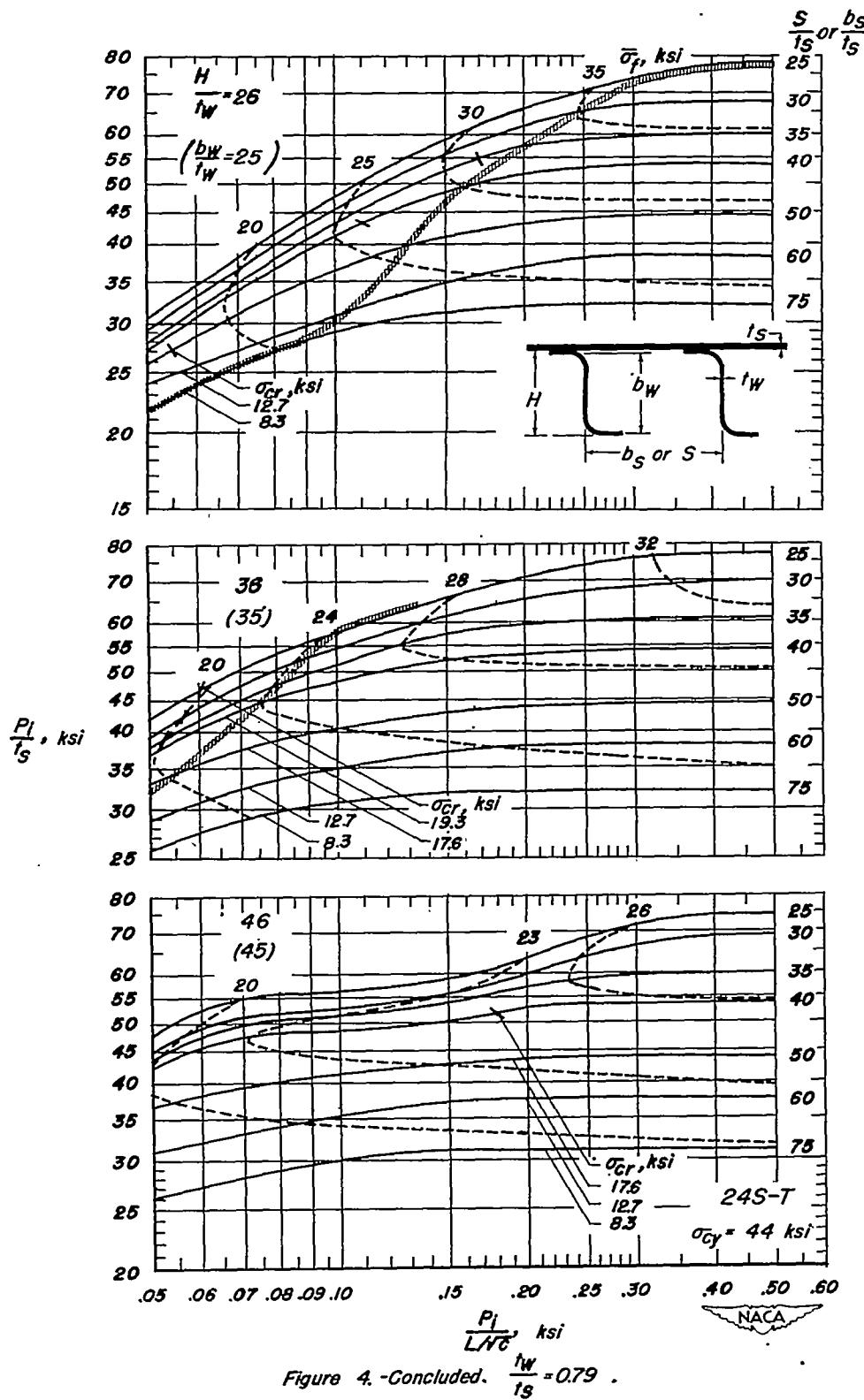


Figure 4.-Direct-reading design chart for 24S-T aluminum-alloy Z-stiffened panels. $\frac{t_w}{t_s} = 0.79$.

Figure 4. -Concluded. $t_w/t_s = 0.79$.

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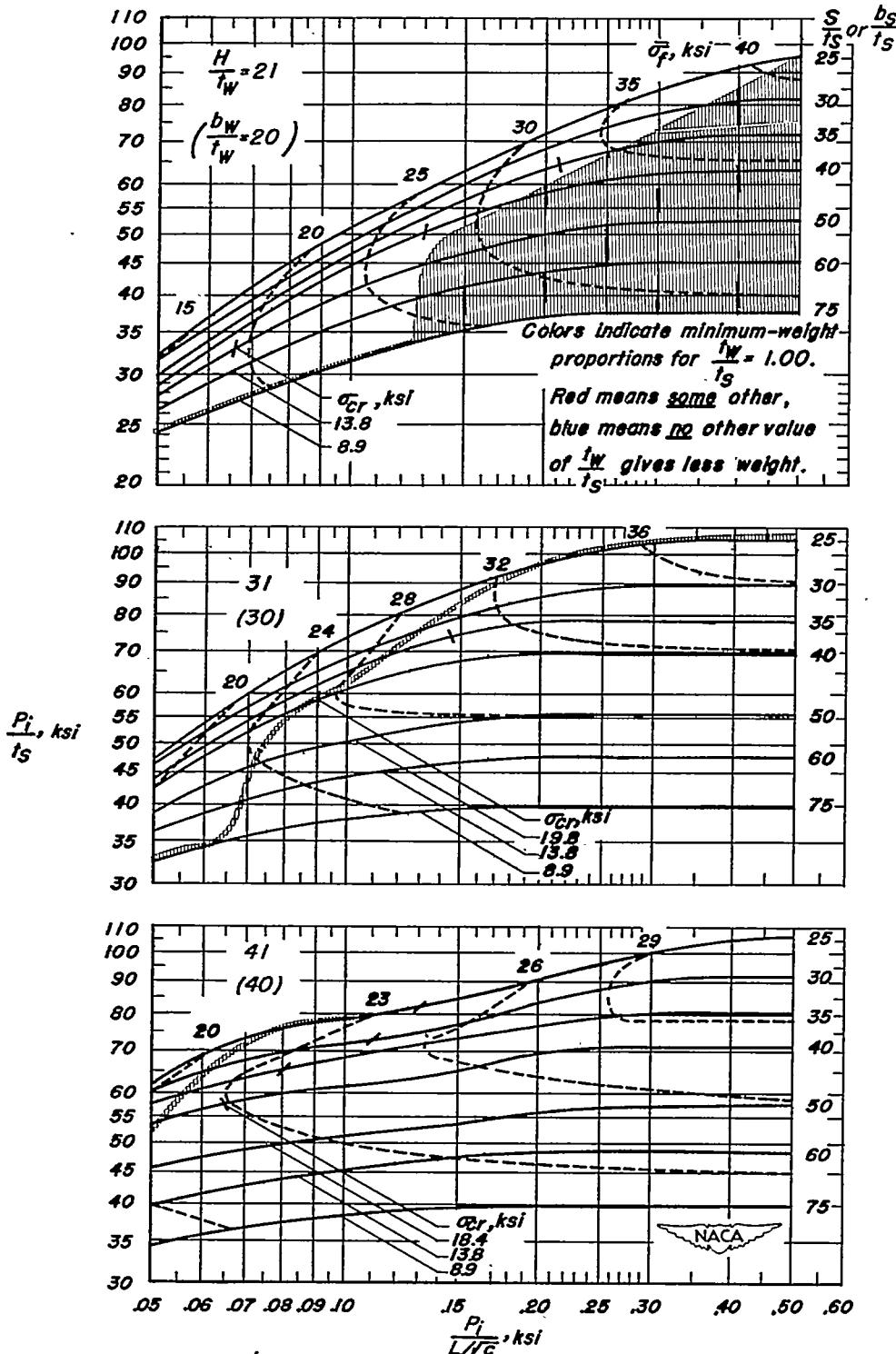
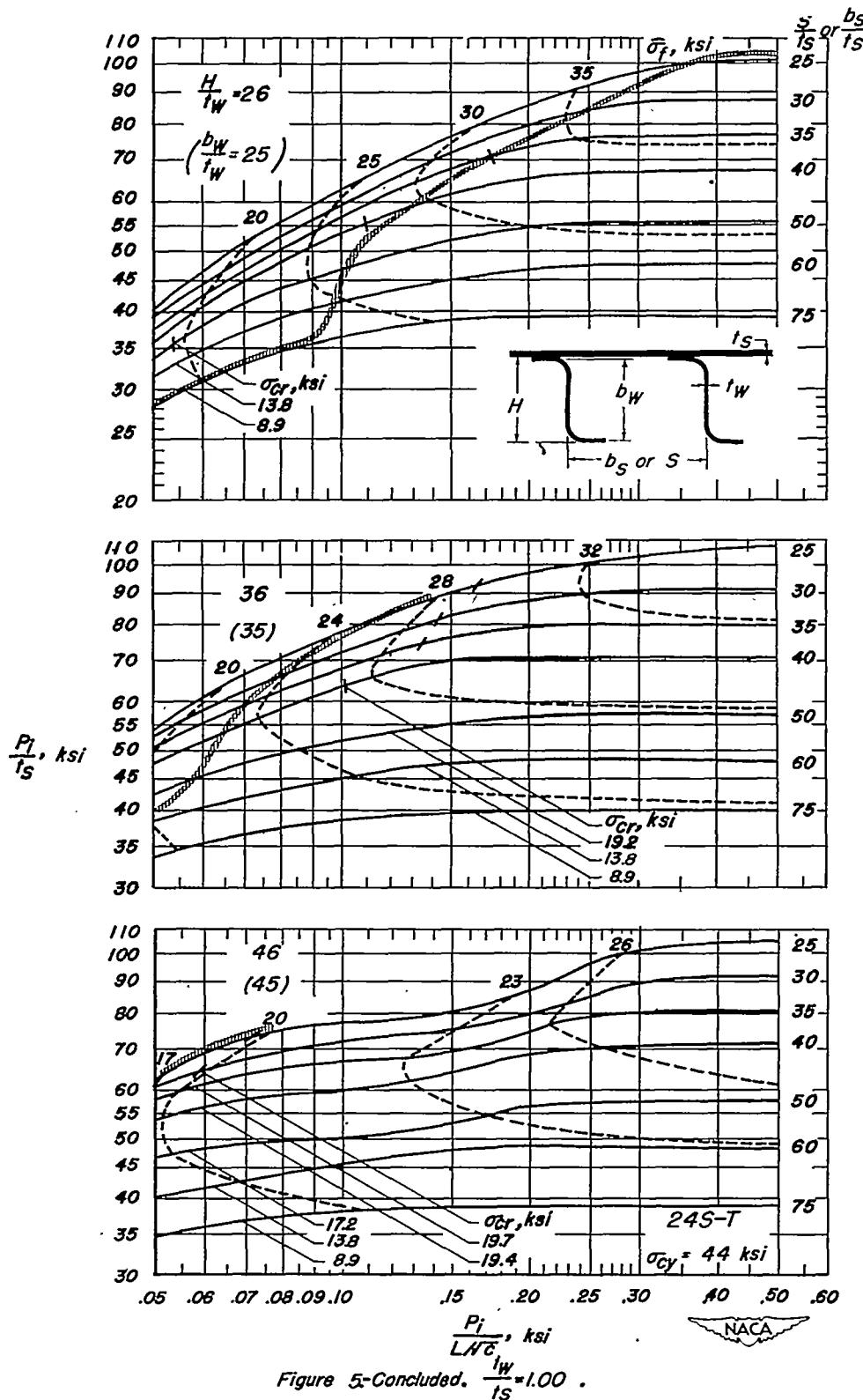


Figure 5-Direct-reading design chart for 24S-T aluminum-alloy Z-stiffened panels. $\frac{t_W}{t_S} = 1.00$.



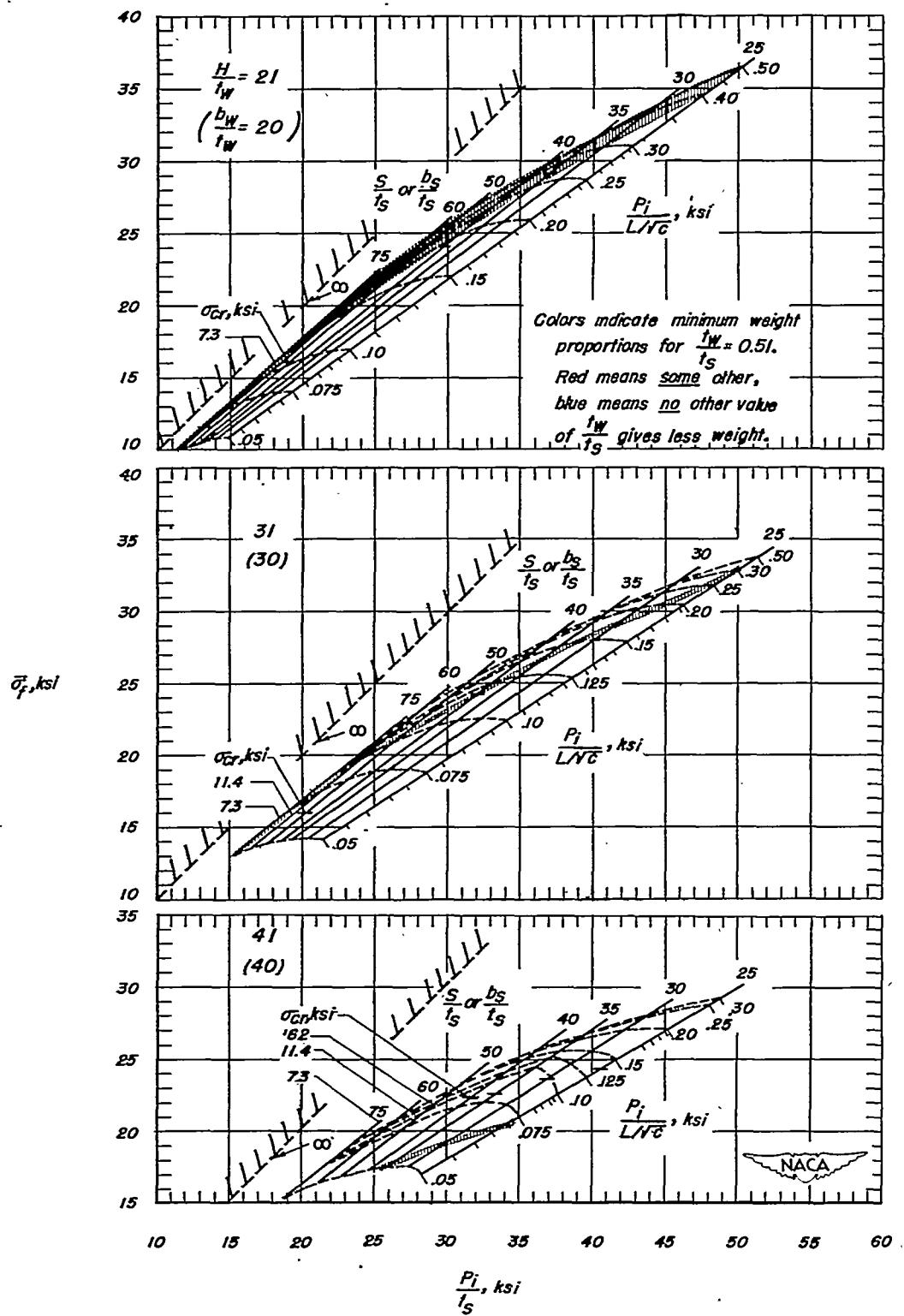
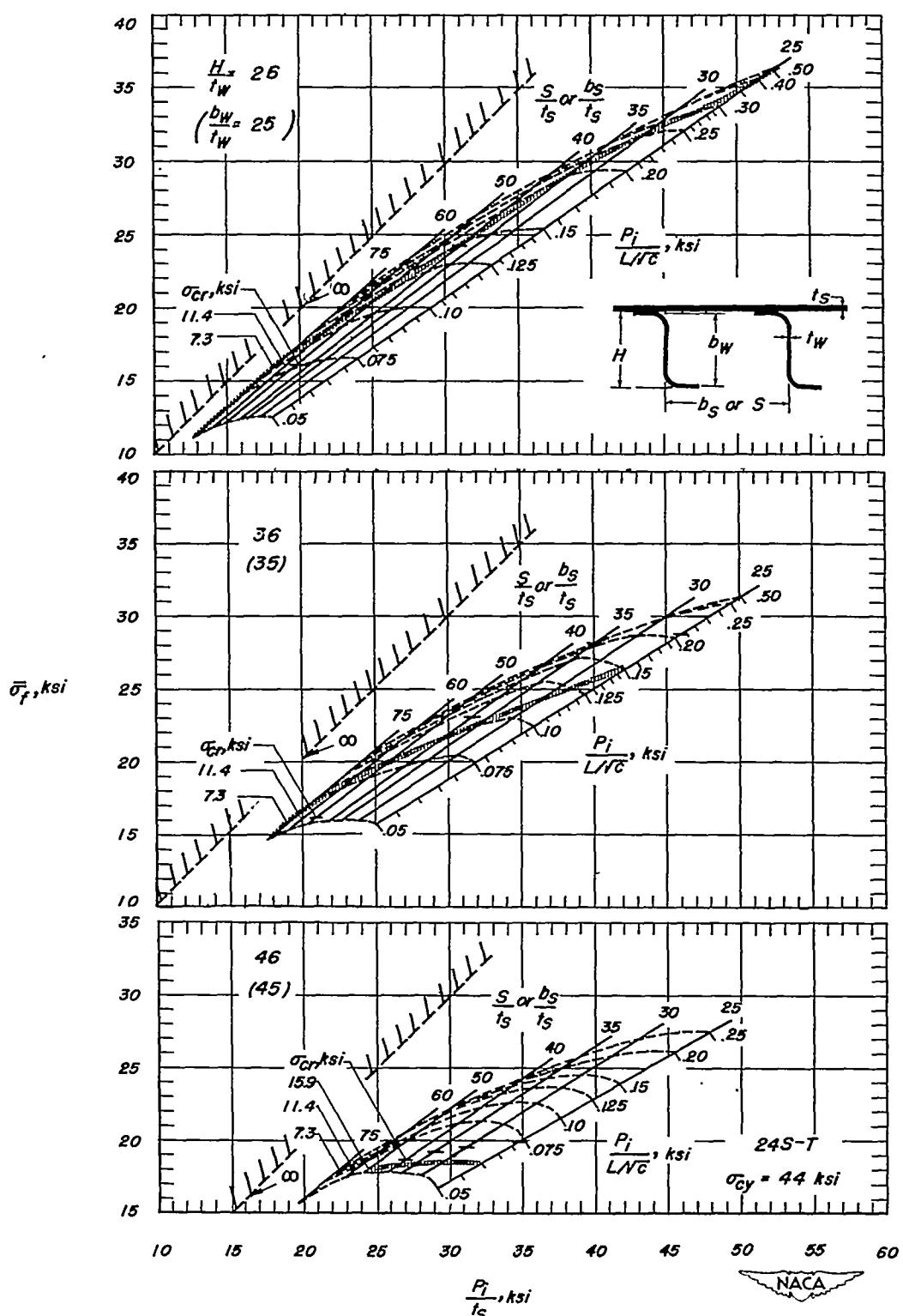


Figure 6.-Direct-reading design chart (alternate form) for 24S-T aluminum-alloy Z-stiffened panels. $\frac{t_w}{t_s} = 0.51$.

Figure 6.-Concluded. $\frac{t_w}{t_s} = 0.51$.

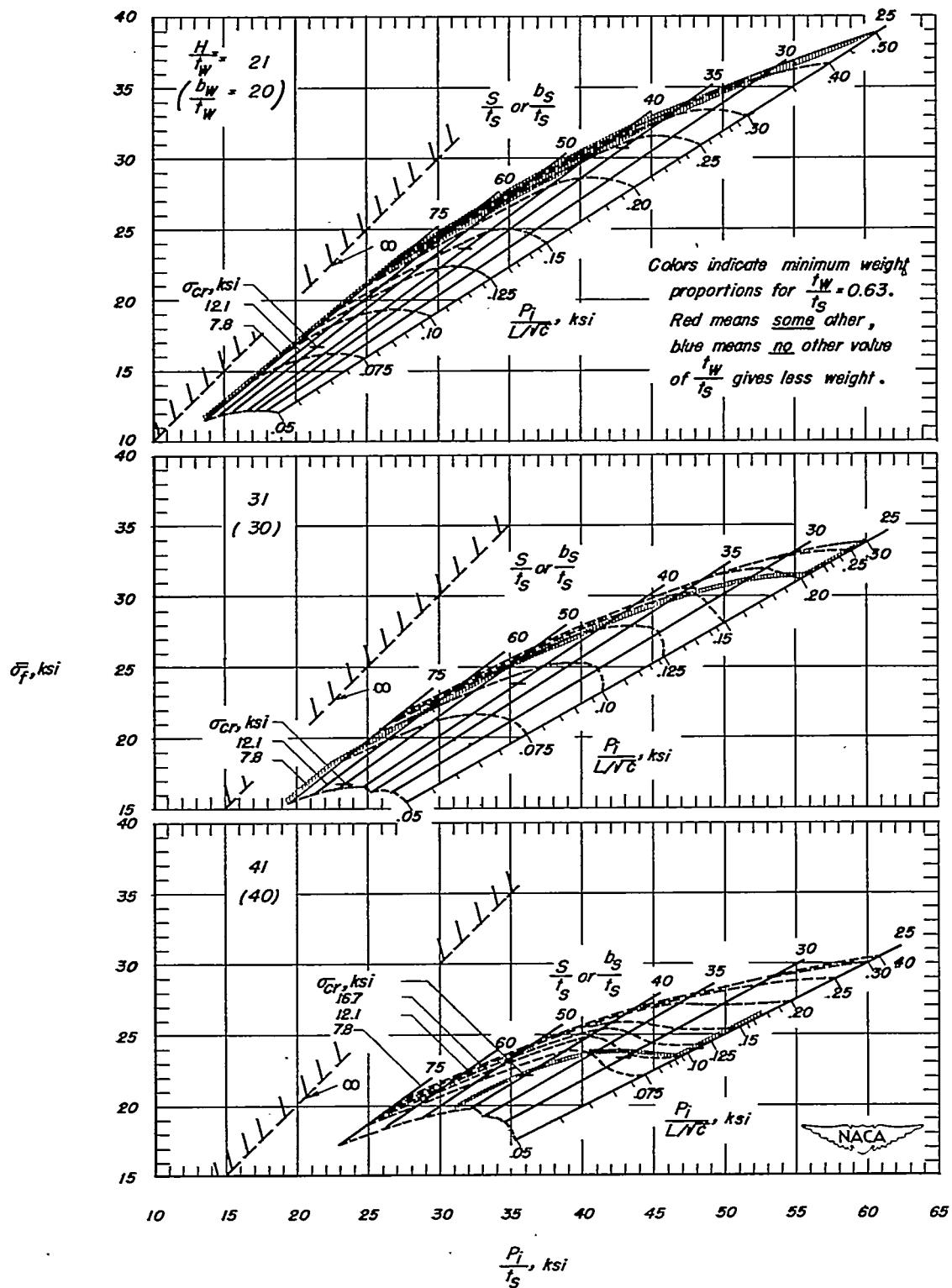


Figure 7.-Direct-reading design chart (alternate form) for 24S-T aluminum-alloy Z-stiffened panels. $\frac{t_w}{t_s} = 0.63$.

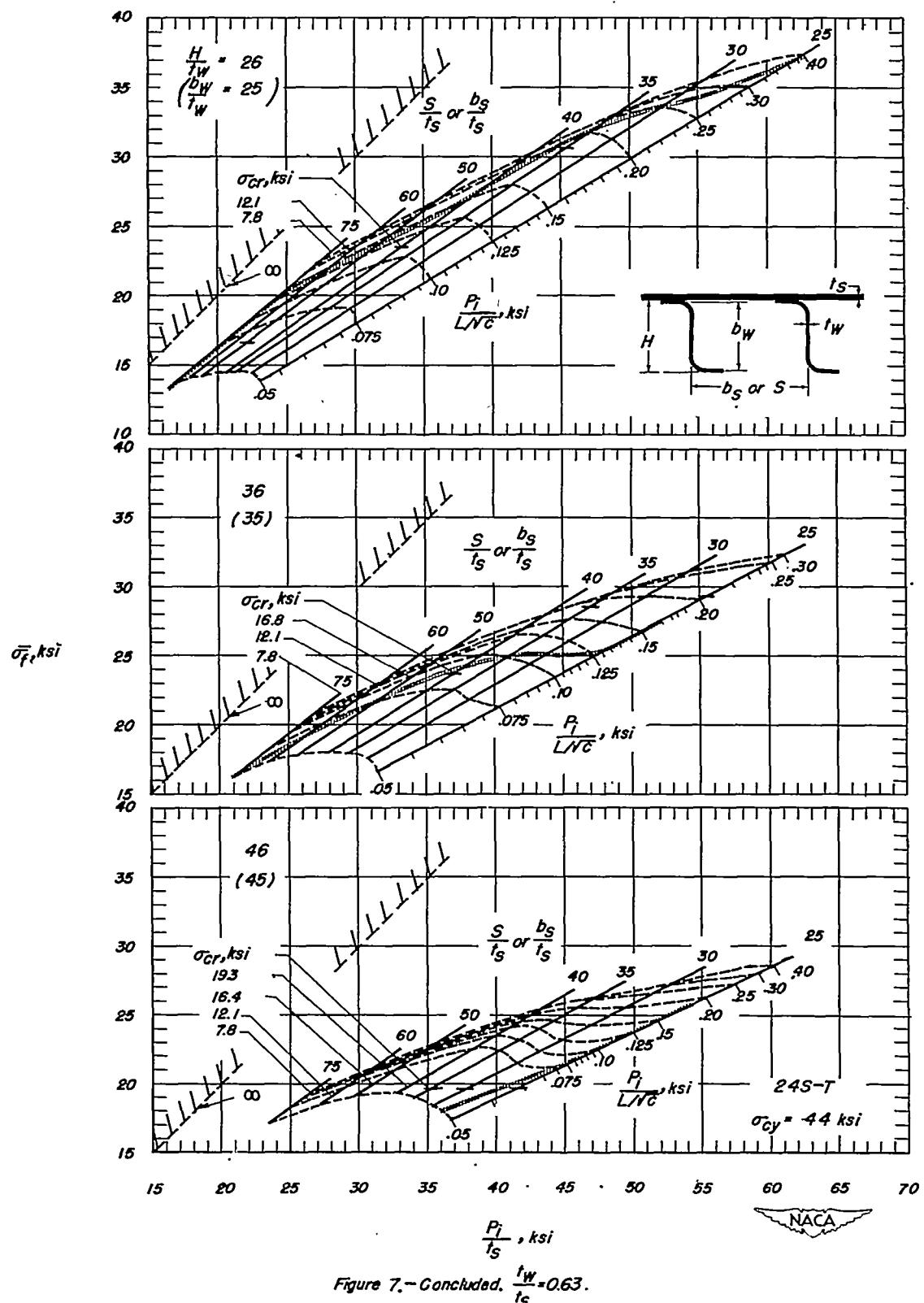


Figure 7.—Concluded. $t_w/t_s = 0.63$.

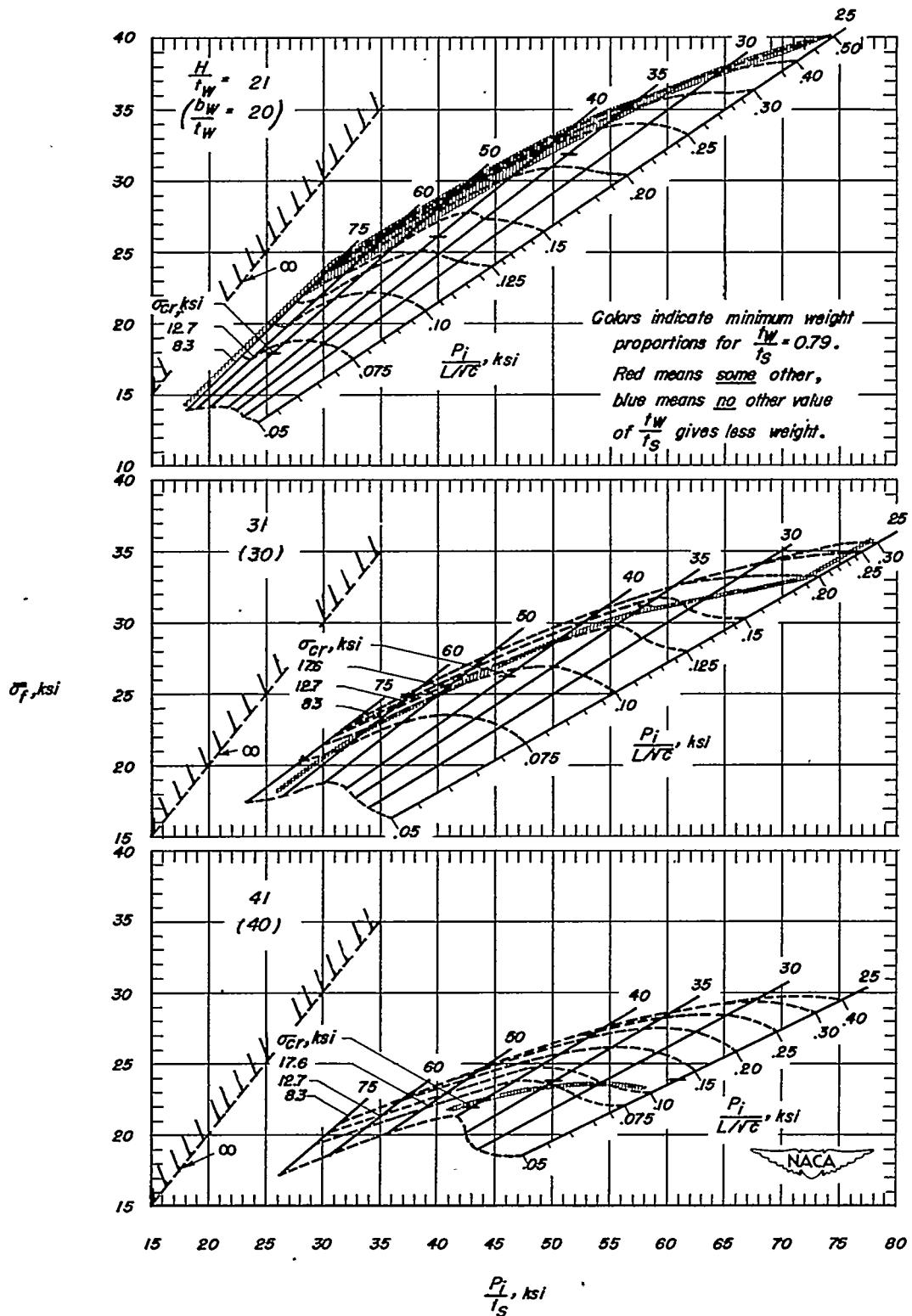
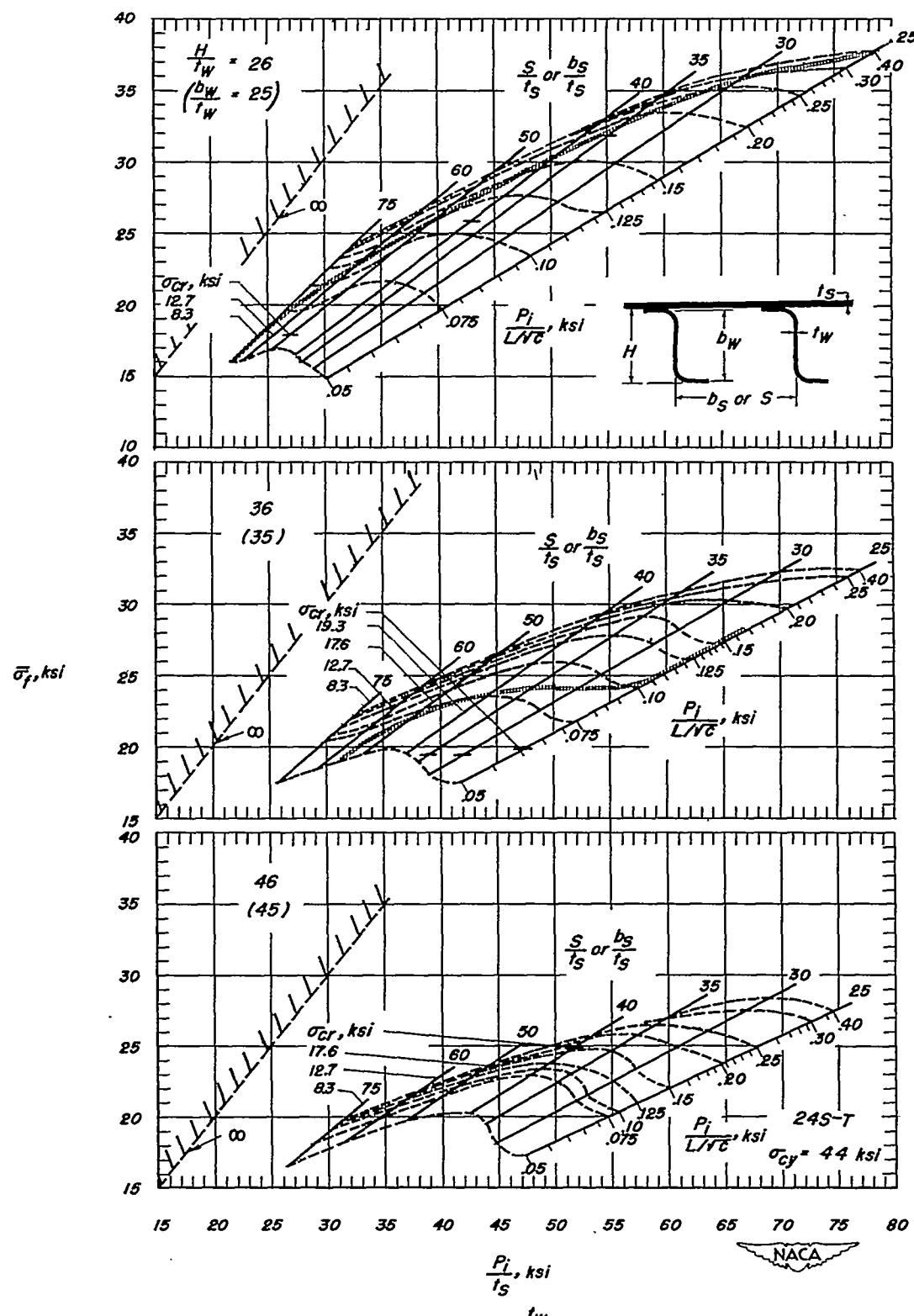


Figure 8.—Direct-reading design chart (alternate form) for 24S-T aluminum-alloy Z-stiffened panels. $\frac{t_w}{t_s} = 0.79$.

Figure 8.-Concluded. $\frac{t_w}{t_s} = 0.79$.

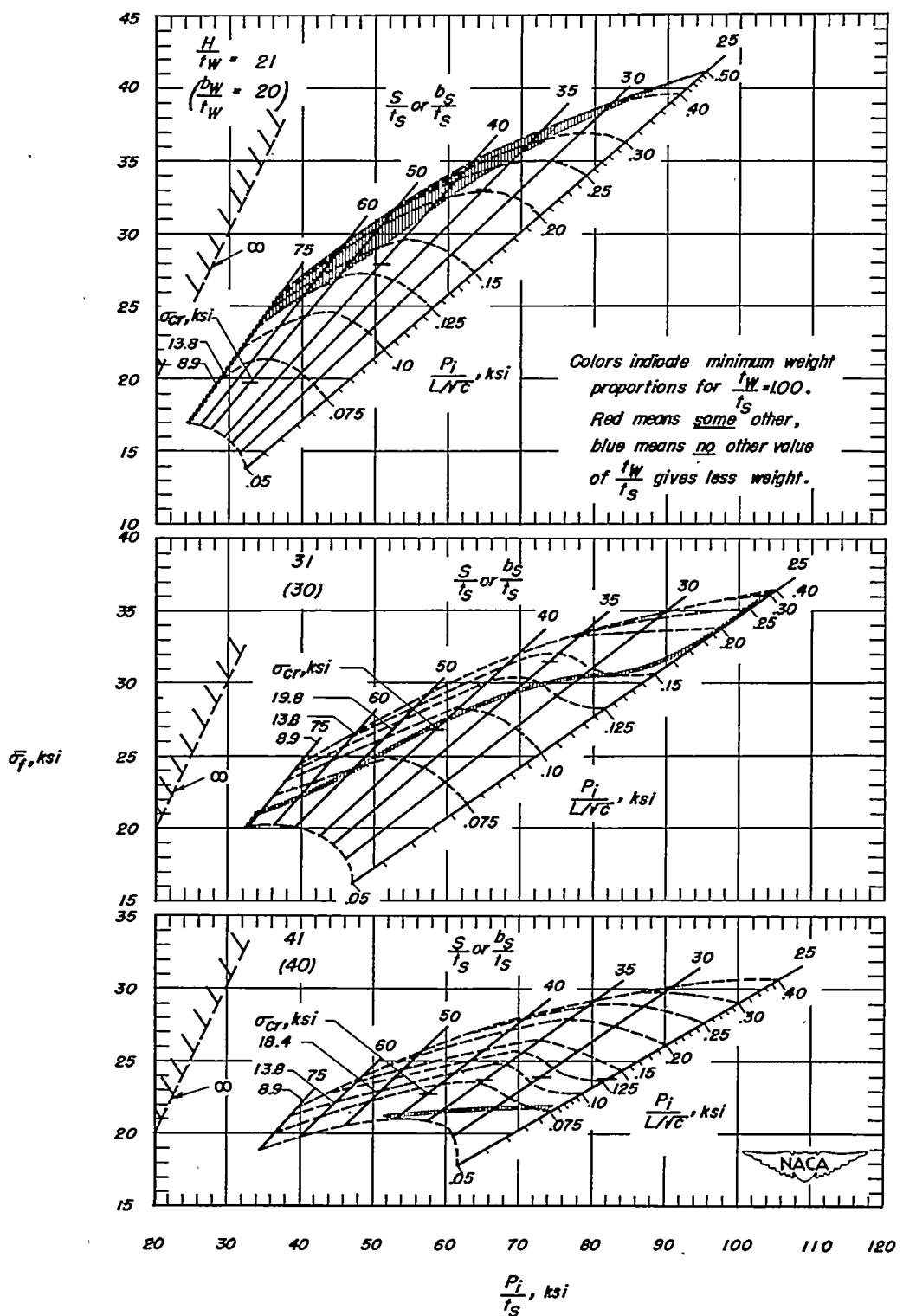
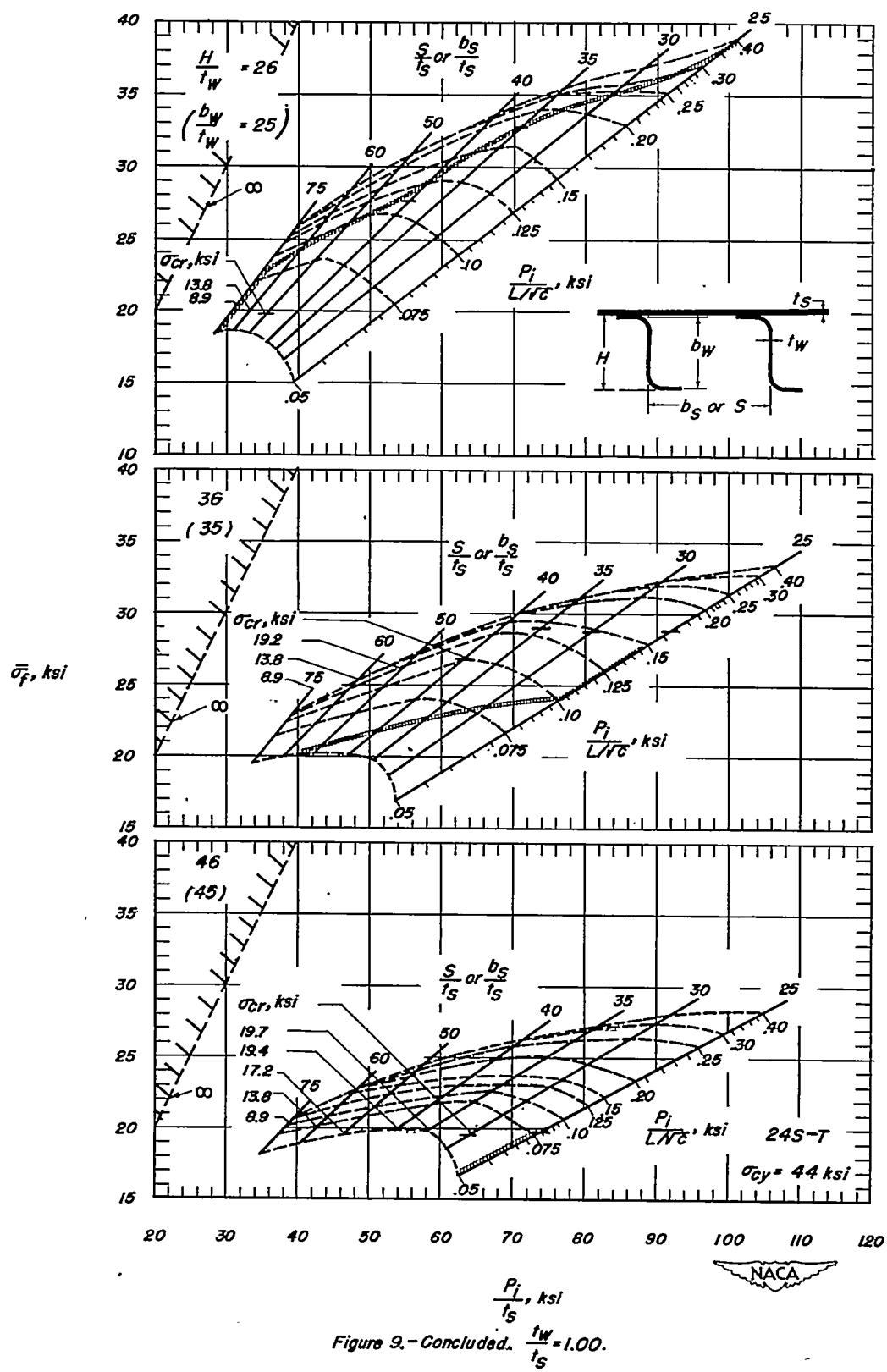


Figure 9—Direct-reading design chart (alternate form) for 24S-T aluminum-alloy Z-stiffened panels. $\frac{t_w}{t_s} = 1.00$.



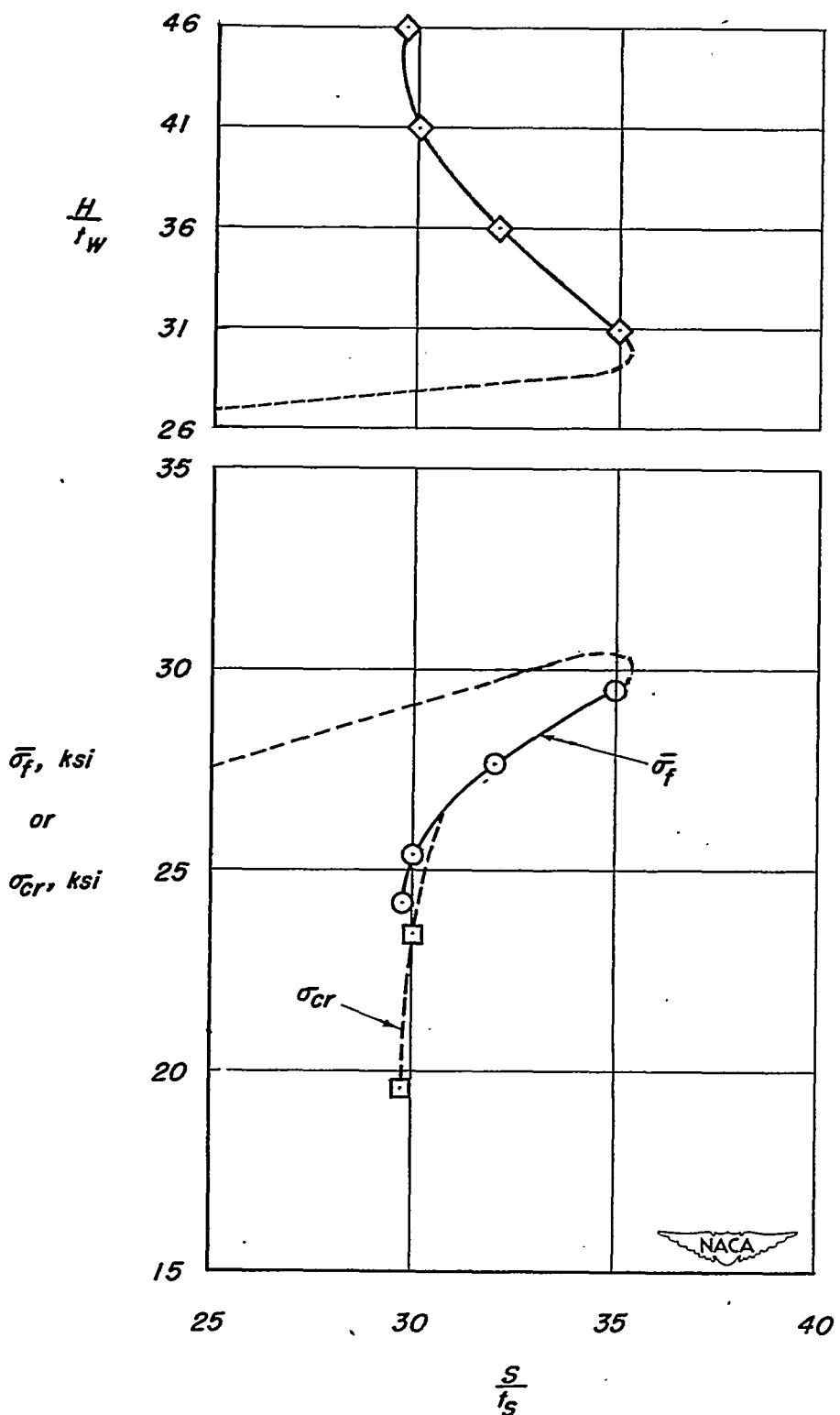


Figure 10.—Plot for obtaining design from design charts.